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MORANG'S
ARITHMETICS



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A modern arithmetic

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MORANG'S MODERN TEXT-BOOKS

A MODERN ARITHMETIC

BOOK I

BY

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VICE-PRINCIPAL NORMAL SCHOOL, WINNIPEG

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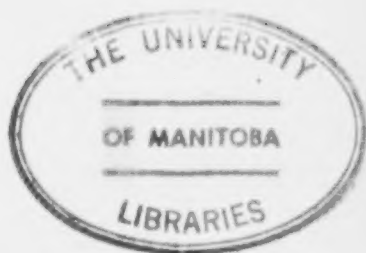
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PREFACE

COMPLAINTS have often been made that the results obtained from the study of arithmetic in the public schools are not commensurate with the amount of time devoted to the subject. These complaints are due, no doubt, to the fact that arithmetic has been taught far too frequently as the art of mechanical computation, the true significance of the processes employed being concealed both from the teacher and from the pupil. The delicacy and accuracy of the thought involved in the mathematical processes have the highest educational value. To treat these processes as a mere routine not susceptible of explanation is to destroy in large measure the value of arithmetic as an educational instrument, and to aid in arresting the mental development of the pupil. An attempt has therefore been made in this series to abridge and enrich the course by omitting such subjects as perplex and exhaust the pupil without affording any really valuable mental culture, and by adding a greater number of exercises in simple calculation and in the solution of concrete problems. An attempt has also been made to present the subject in such a manner as to minimize any temptation on the part of the teacher or the pupil to reduce the subject to mechanics.

The problem of preparing a work upon elementary arithmetic may be attacked from various standpoints: The author may confine himself to the giving of so-called model lessons; he may proceed dogmatically, and may lay down hard and fast rules for teaching, excusing the destruction of the

teacher's independence by the thought that the end will in all probability justify the means; he may take advantage of the occasion to exploit hobbies which he had aforetime successfully ridden; he may confine himself to those devices which occupy so much time in the ordinary training of the teacher; or he may endeavor to present the subject in such an order that pleasure and interest may come, not from any environment, not from the peculiar individuality of the class, but because the problems have been so graded and stated that the pupil's progress becomes one of self-development. The last is the standpoint attempted in this series. The subject of arithmetic has been considered in the light of an evolution. Comparative methods rather than dogmatic statements is the underlying feature of the methods employed. Certain types, it is true, are suggested, but these are given as representing the present development of the subject and not as finalities.

In this effort to set forth the subject as a growth the teacher must contribute. No book can take the place of an enthusiastic, resourceful teacher. The teacher who does not anticipate difficulties which would otherwise be discouraging to the pupil, modifying these difficulties, but not wholly removing them, by skilful questions, is not doing the best kind of work. On the other hand, the teacher who overdevelops, who seeks to eliminate all difficulties, who attempts to do all the thinking for the class, is equally at fault. The text should never be a master to be feared, but rather a servant to assist. In the lower grades, while the teacher should seek to follow the general lines of the book, each new principle should be discovered by the class in advance of the assignment of book work. If the author's plan is reasonably satisfactory, it should be followed, in order that the pupil may be able to review the subject without any waste of time. A great many hours

are squandered by teachers in attempting to develop something along some line not followed by the text-book in hand, when the author's method is quite as good — perhaps better.

While reviews may fail from their very stupidity, the skilful teacher is always reviewing in connection with the advance of work. There is one season, however, when a review is essential. This is at the opening of the school year. Such a refreshing of the mind places both pupil and teacher in the best of attitudes for the year's work, and will help to lessen the complaints which teachers generally make regarding the character of the work previously done. To aid teachers in this review, exercises covering the work of the previous years have been placed at the beginning of the work of each year.

Mensuration was formerly taught solely by rule. Even now the strictly scientific treatment belongs to geometry. There are certain propositions so commonly needed, however, that they must have a place in arithmetic for their arithmetical value, and also because many of the students may not study geometry. Such are the propositions which give the formulæ for measuring simple surfaces and solids, the mensuration for all of which may and should easily be taken up in arithmetic in a reasonably scientific way.

If this series may help, even in a small way, to open a wider field, or to offer a better point of view to some one just entering the profession, the author will feel repaid for his labors.

WINNIPEG,
June 15, 1904.

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A MODERN ARITHMETIC

BOOK I. — PART I

REVIEW OF THE MATHEMATICS OF PREVIOUS GRADES

Exercise 1

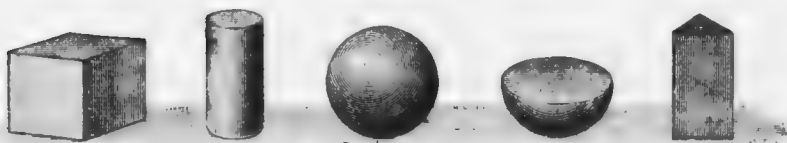


FIG. A

1. Name the forms in Figure A from left to right and from right to left. Select from the box the hemisphere, cylinder, and right-angled triangular prism.

2. How does the cube differ from the sphere? In what way is the sphere like the cylinder and the cylinder like the prism?

3. How many sides or faces, edges, and corners have the cube and the prism? How many faces and edges have the cylinder and the hemisphere?

4. What is the shape of each face of a cube? Is Figure B a square? How many edges bound a square? Draw a square on the blackboard.

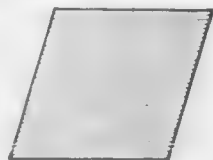


FIG. B

5. Can you hold a cube so that eight of its edges will be *horizontal*? so that four edges will be horizontal? so that no edge will be horizontal?

6. Hold the cube so that four edges will be *vertical*. What is the position of the remaining edges of the cube?

7. Compare the faces of the cube as to shape and size.

8. What is the difference between the surface of the sphere and that of the cube? the surface of the cylinder and that of the hemisphere?

9. How many of the forms in Figure A have curved surfaces? How many have flat or *plane* surfaces? How do you tell when a surface is plane?

10. Can you draw straight lines on the cube, the cylinder, and the sphere?

11. Draw the ends of a cylinder and a prism on the blackboard. What do you call these forms?

12. What would you call a square having each side two inches long? Each side half an inch long? What would you call a cube having each side three inches long? How many inch cubes would you have to take to make such a cube? Test whether you are correct in your answer.

13. Name objects like the cylinder. Name others like the sphere, the hemisphere, the prism, or the cube.

Exercise 2

1. Find how many steps you will take in pacing the length of the schoolroom. What is the width of the school yard in *paces*? How long is your pace? Is this the same for all the members of the class?

2. If the distance from the school door to the gate were given as twenty-five paces, would you need to know anything else about it to be certain of this distance? What is

this? Do you think the pace a good measure? Can you name a better measure? In what way is this better?

3. Place (judging the distance with the eye) points on the blackboard an inch apart; six inches apart; a foot apart; a yard apart. Test the distances measured.

4. How tall is the tallest boy in the school? How tall are you?

5. Measure with the eye the height of the top of the window-sill, the width of the school door, the distance from the door to the gate, the width of the road. Test your answers with the foot-rule and the yardstick.

6. An inch in each of the following lines stands for a length of six feet. What length does each represent?

a —————

b —————

c —————

d —————

7. Find in feet the length and the width of the school-room. How many yards long is the room? How did you find this?

8. A room is twenty-four feet long and twenty feet wide. Find the distance round the room.

9. If the distance round the room were ninety-six feet and the width twenty-three feet, what is the length?

10. Find the length of the curved line in Figure A.



FIG. A

Exercise 3

1. Name the Canadian copper coins. Name the Canadian silver coins.
2. How many five-cent pieces should you get in change for a twenty-five-cent piece? a fifty-cent piece? a ten-cent piece?
3. One dollar is equal to how many fifty-cent pieces? how many ten-cent pieces? how many five-cent pieces? how many twenty-five-cent pieces?
4. If one dollar be paid for two pounds of candy, what part of two pounds can be bought for a fifty-cent piece? a ten-cent piece? a twenty-five-cent piece? two quarters and a ten-cent piece?
5. How many fifty-cent pieces must be paid for an article costing three dollars? How many quarters must be paid for an article costing four dollars?
6. Read as dollars and cents: \$7.25; \$16.05; \$13.50.
7. Write as dollars and cents: Three dollars and seventy-five cents; five dollars and fifty-three cents; eighty-five cents.
8. Willie gave seventy-five cents for a book and thirty-five cents for a school bag. What change should he get out of a two-dollar bill?
9. Mary bought three pounds of rice at nine cents a pound and handed the grocer a dollar bill. What change should Mary get? How did the grocer count the change due Mary?

NOTE. — Giving the rice, he would count that twenty-seven cents, then placing in her hand three cents, ten cents, ten cents, and fifty cents, he would count thirty, forty, fifty, one dollar. This is the most convenient way and the one least liable to error.

10. Having only five and ten cent pieces, how will the change be counted when fifteen cents is to be taken from a dollar? when thirty-five cents is to be taken from three dollars? when eight cents is to be taken from two half-dollars?

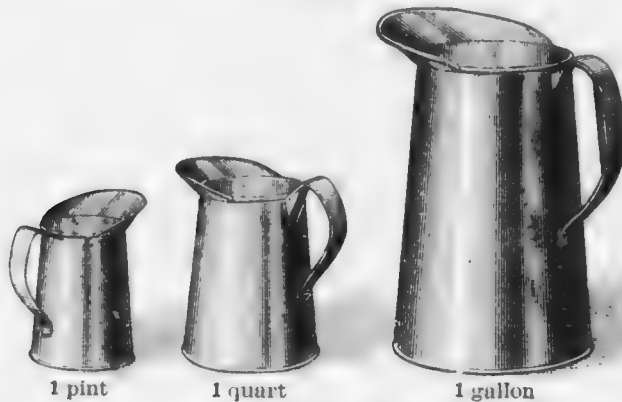
Exercise 4

FIG. A

1. What do we buy or sell by pints, quarts, and gallons?
2. A quart is how many times as large as a pint? A quart is what part of a gallon?
3. A pint is equal to what part of a quart? A quart is how much more than one pint and how much less than one gallon?
4. A quart of water is how many times as heavy as a pint of water? A gallon of water is how many times as heavy as a pint of water? as a quart of water?
5. If we were to call a pint 1, what should we call a quart? a gallon? How often will you have to empty a pint measure full of water into an empty pail to pour in three and one-half quarts of water?
6. If your school had only a pint measure, how would you use it in order to make a quart measure? a gallon measure?

7. From a pailful of milk thirteen pints and two quarts were taken. Half a gallon of milk still remained. Find the size of the pail in pints; in quarts; in gallons.

8. How often will a bottle holding one gallon and three quarts fill a bowl holding two pints?

9. How much must you add to two gallons to make it equal to twenty-three pints? to nineteen quarts? to thirteen quarts eighteen pints?

10. If a gallon of milk cost twenty-four cents, what will three quarts of milk cost? How did you find this result?

11. You are asked to get a box holding an exact peck, and are given a pint measure to assist you. How will you proceed?

12. Potatoes were bought at sixty cents a bushel and sold so as to gain ten cents per peck. Find the selling price of three bushels of the potatoes.

Exercise 5

1. If a wire fence costs thirty cents per yard, find the price of a foot.

2. From a board seven feet five inches in length a carpenter cut a piece ten inches long. Find in inches the length of the remainder. How much is this longer than two yards?

3. How many feet are there in eighty-four inches? in sixty-six inches? in two feet nine inches?

4. Three boards, of lengths two feet three inches, five feet eight inches, and nine feet two inches, are placed end to end to form a walk. Find the length of the walk.

5. How many inches are there in two feet three inches? in three feet four inches? in one and one-half yards? in two yards one foot?

6. From a ribbon a yard long, a piece measuring nine inches has been cut. How much is left? What part is left?

7. Which is the cheaper and how much:

(a) Six cents an inch or sixty cents a foot?

(b) Ten cents a foot or thirty-five cents a yard?

(c) Twenty-four cents for eight inches or one dollar a yard?

8. A box is two feet three inches long, one foot four inches wide. Find its *perimeter* (distance round).

9. What part of a yard is eighteen inches? two feet? nine inches? twenty-seven inches? three inches?

10. What part of a foot is eight inches? six inches? four inches? nine inches? two inches?

Exercise 6

1. How many hours are there in two days? in one and one-half days? in three days?

2. What part of a day is sixteen hours? eight hours? from midnight to midday? What part of a week is three days? twenty-four hours? three days twelve hours? forty-eight hours?

3. A man can earn thirty cents an hour. What can he earn from seven o'clock in the morning until three o'clock in the afternoon? How many hours from 6 o'clock A.M. (before noon) until 11 o'clock P.M. (afternoon)?

4. When the minute hand of a clock is 13 minute spaces past XII, and the hour hand is between VII and VIII, what time is it? When the hour hand is between X and XI, and the minute hand is 3 spaces beyond II, what time is it?

5. When the hour hand is between XII and I, and the minute hand is at VIII, what time is it? When the minute hand is 14 spaces beyond IX, and the hour hand is between VIII and IX, what time is it?

6. When it is 23 o'clock by a railway timepiece, what o'clock is it on an ordinary timepiece? when it is 18 o'clock? when it is 21 o'clock? Two o'clock P.M. on an ordinary clock is what time on a railway clock? 11 o'clock P.M. is what time? 7 o'clock P.M. is what time?

7. Which is the cheaper :

(a) Twenty cents an hour for a day of 4 hours or seventy-five cents a day?

(b) Three dollars a day or seventeen dollars per working week?

8. How many days are there in 4 weeks? in 7 weeks? in half the month of August? in 13 weeks? in each of the months, September, June, April, and November? in the year 1904? in the year 1905?

9. How many hours are there in $\frac{3}{4}$ of a day? in $\frac{5}{8}$ of a day?

10. How many days from January 10th to February 14th? from February 15th, 1904, to March 19th? from March 19th to April 27th?

Exercise 7

1. How many sheets of paper in one quire? in one ream? One-fourth of a ream is how many quires? how many sheets?

2. John bought a quire and a half of note paper at three dollars a ream and sold it at two cents a sheet. How much did he gain or lose?

3. If one sheet of foolscap sells for one cent, find the selling price of a ream; a quire, half a ream, and three-fourths of a quire.

4. Harry bought some pens at ten cents a dozen and sold them at two cents each. Find his gain on the sale of five dozen pens; a dozen and a half pens; thirty-six pens; ninety pens.

5. How many ounces in two pounds? three pounds? six pounds? two and one-half pounds? three-quarters of a pound?

6. How many pounds in thirty-two ounces? twenty-four ounces? thirty ounces? forty-eight ounces? fifty-six ounces?

7. At two cents an ounce what will three pounds of butter cost?

8. Figure A is a mile square, or *section*. Its surface or *area* is six hundred and forty acres. How does the diameter *AB* divide the section? How does the diameter *CD* divide the section? What is the shape of each of the four smaller blocks into which the section is divided? Each of these is called a *quarter-section*.

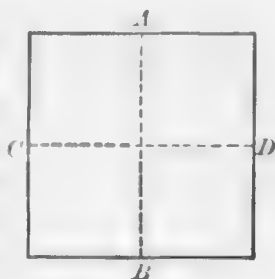


FIG. A

Exercise 8

1. Nine is what part of twelve? Fifteen is what part of eighteen?

2. Two-fifths of a post is above and nine feet below ground. How long is the post?

3. Tom has twenty-four cents. He spent three-eighths of this and lost one-quarter of it. What part of the whole has he left? What part of the whole has he spent?

4. Three sheep are given in exchange (trade) for five pigs. At this rate how many sheep should be given for fifteen pigs?

5. Of thirty apples, one-third are red, one-fifth are yellow, and the remainder green. How many are green?

6. Rice is eight cents a pound. Find the cost of two and three-quarters pounds of rice.

7. Fifteen is five-eighths of what number and three-fifths of what other number?
8. To three-sevenths of twenty-eight add five-sixths of fifty-four. What is the number? Thirty-eight is what part of this number?
9. Twenty-one is seven-ninths of what number?
10. Three-fourths of twelve is what part of twenty-seven? Five-ninths of thirty-six is what part of twenty-five?
11. What part of thirty-six is two-thirds of twenty-seven? What part of twenty-four is two-thirds of twenty-four added to one-sixth of twenty-four?
12. Three-fourths of sixteen is two-thirds of what number?
13. Three men own fifteen horses. One man owns one-third, another two-fifths. How many horses does the third man own? What part of the whole herd does he own?
14. Charlie has sixteen oranges. He gave three-eighths to Tom and one-fourth to Kenneth. What part has he left? How many more had Tom than Kenneth? How much more?
15. Eight is two-thirds of some number. What is three-fourths of this number?
16. What number added to three-fourths of twenty-four will make seven-eighths of twenty-four? What part of twenty-four has been added?
17. Five times four and three-fourths of four are how many?
18. Four-sevenths of fifty-six is how many times four?
19. A man collected twenty-four dollars from one debtor, sixteen dollars from a second, and eleven dollars from a third. With this money he was able to pay three-fourths of his debts. How much does he still owe?

Exercise 9

Add:

1.	4	3	4	3	3	7	6	5	9
	3	2	5	4	6	8	9	4	7
	2	2	2	5	4	1	5	4	8
	6	3	5	3	5	3	8	3	7
	2	3	3	3	3	9	4	5	6
	3	4	5	7	2	6	7	7	4
2.	7	8	7	7	3	6	7	9	3
	3	7	2	7	7	3	6	6	3
	4	9	4	6	8	3	5	4	3
	5	6	6	6	7	4	5	5	4
	4	6	9	5	6	4	7	4	4
	6	3	8	8	9	3	4	2	5
3.	2	5	8	2	6	2	5	6	7
	4	4	5	3	7	5	8	9	7
	5	3	9	3	5	3	6	7	7
	3	5	4	5	9	5	5	4	3
	5	6	6	8	4	8	9	4	8
	6	5	7	6	9	7	4	8	8
4.	4	5	2	7	6	9	8	7	3
	5	3	5	4	4	6	6	3	3
	3	2	3	3	4	5	3	9	6
	5	4	5	2	9	4	3	4	4
	6	8	6	5	2	8	7	7	9
	6	4	8	4	4	9	9	7	9

Add:

5. 27 and 8; 37 and 18; 17 and 8; 57 and 18; 46 and 8;
26 and 8; 56 and 18; 38 and 8; 18 and 8; 25 and 8: 55
and 18.

6. 27 and 9; 47 and 19; 38 and 9; 18 and 9; 35 and 9; 15 and 9; 46 and 9; 16 and 9; 73 and 9; 85 and 9.

7. 65 and 7; 15 and 17; 75 and 7; 38 and 7; 18 and 7; 46 and 7; 57 and 7; 87 and 6; 17 and 6; 58 and 6; 18 and 6.

NOTE. — In the additions of questions 8 and 9 the pupils should take advantage of the decimal system, *e.g.* 27 and 35 is equal to two tens and seven and three tens and five — is equal to five tens and twelve — is equal to six tens and two.

Add:

8.	12	14	35	26	44	38	25	57	18
	<u>19</u>	<u>24</u>	<u>51</u>	<u>37</u>	<u>29</u>	<u>57</u>	<u>56</u>	<u>25</u>	<u>24</u>
9.	13	23	45	39	54	27	29	33	77
	<u>27</u>	<u>34</u>	<u>35</u>	<u>13</u>	<u>27</u>	<u>31</u>	<u>19</u>	<u>46</u>	<u>17</u>

10. Find the sum of:

$$17 + 15 + 10 + 18; 47 + 18 + 15;$$

$$12 + 13 + 20 + 14 + 16; 14 + 16 + 18 + 13.$$

11. Add by sevens from one to seventy-one; by eights from two to ninety-eight, and by nines from three to ninety-three.

12. Read the following numbers: 73, 37, 69, 93, 17, 01, and 100. Write in figures: nine, nineteen, and ninety, and in words: 27, 35, 70, 66, and 14.

13. Read: IX, XXVI, XLV, LXXXIV, XCIII, and CX. Write in Roman characters 8, 18, 38, and 98.

Exercise 10

1. Tom gave 8 pears to William, 12 to Charles, 9 to James, and had 11 left. How many had he at first?

2. A grocer paid 37 dollars for flour and 29 dollars for oatmeal. What did both cost him?

3. A fisherman caught 13 trout on Monday, 28 on Tuesday, and 37 on Wednesday. How many fish were caught?

4. At an auction sale a man bought a binder for 39 dollars, a hay-rake for 17 dollars, and a cultivator for 9 dollars. How much would he have to pay for all?

5. A farmer sold 7 pigs at 8 dollars each and a cow at 35 dollars. How much should he receive?

6. Harry bought a book for 18 cents, a lead pencil for 5 cents, a scribbler for 4 cents, and some pens for 8 cents. What did he pay for all?

7. A farmer sold three loads of wheat. The first load contained 17 bushels, the second 23 bushels, and the third as many as the first and second loads together. How many bushels of wheat were sold?

8. A man began business with 28 thousand dollars and in 7 years he cleared 67 thousand dollars. How much was he then worth?

9. A man bought a horse, a saddle, and a bridle. For the bridle he gave 4 dollars, for the saddle 5 dollars more than this, and for the horse 54 dollars more than for the saddle and the bridle. How much did the horse cost? How much did all cost?

10. A grocer mixed 17 pounds of tea worth 35 cents a pound with 19 pounds of tea worth 65 cents a pound. Find how many pounds there were in the mixture.

11. Two boys set out to walk from the same place, in opposite directions. One boy travelled 32 miles, and the other 27 miles. How far are they apart?

12. The attendance at a certain village school is as follows: in grade one, 18 boys and 23 girls; in grade two, 15 boys and 18 girls; and in grade three, 25 boys and 32

girls. Find how many boys attended school; how many girls. What was the total attendance?

13. A horse ate one peck 3 quarts of oats on Monday, 3 gallons of oats on Tuesday, and one gallon 6 quarts of oats on Wednesday. Find how many pecks, gallons, and quarts of oats were eaten during the three days.

14. Mary gathered 2 dozen and 9 eggs one week and 3 dozen and 4 eggs the next. How many eggs were gathered all together?

Subtract :

Exercise 11

1.	$\begin{array}{r} 31 \\ 19 \\ \hline \end{array}$	$\begin{array}{r} 41 \\ 18 \\ \hline \end{array}$	$\begin{array}{r} 51 \\ 27 \\ \hline \end{array}$	$\begin{array}{r} 61 \\ 36 \\ \hline \end{array}$	$\begin{array}{r} 71 \\ 45 \\ \hline \end{array}$	$\begin{array}{r} 81 \\ 64 \\ \hline \end{array}$	$\begin{array}{r} 91 \\ 73 \\ \hline \end{array}$
2.	$\begin{array}{r} 42 \\ 27 \\ \hline \end{array}$	$\begin{array}{r} 52 \\ 36 \\ \hline \end{array}$	$\begin{array}{r} 62 \\ 25 \\ \hline \end{array}$	$\begin{array}{r} 72 \\ 44 \\ \hline \end{array}$	$\begin{array}{r} 82 \\ 53 \\ \hline \end{array}$	$\begin{array}{r} 92 \\ 49 \\ \hline \end{array}$	$\begin{array}{r} 32 \\ 18 \\ \hline \end{array}$
3.	$\begin{array}{r} 53 \\ 35 \\ \hline \end{array}$	$\begin{array}{r} 63 \\ 26 \\ \hline \end{array}$	$\begin{array}{r} 73 \\ 34 \\ \hline \end{array}$	$\begin{array}{r} 83 \\ 28 \\ \hline \end{array}$	$\begin{array}{r} 93 \\ 39 \\ \hline \end{array}$	$\begin{array}{r} 33 \\ 17 \\ \hline \end{array}$	$\begin{array}{r} 43 \\ 27 \\ \hline \end{array}$
4.	$\begin{array}{r} 64 \\ 36 \\ \hline \end{array}$	$\begin{array}{r} 74 \\ 26 \\ \hline \end{array}$	$\begin{array}{r} 84 \\ 37 \\ \hline \end{array}$	$\begin{array}{r} 94 \\ 49 \\ \hline \end{array}$	$\begin{array}{r} 34 \\ 19 \\ \hline \end{array}$	$\begin{array}{r} 44 \\ 11 \\ \hline \end{array}$	$\begin{array}{r} 54 \\ 25 \\ \hline \end{array}$
5.	$\begin{array}{r} 75 \\ 48 \\ \hline \end{array}$	$\begin{array}{r} 85 \\ 37 \\ \hline \end{array}$	$\begin{array}{r} 95 \\ 56 \\ \hline \end{array}$	$\begin{array}{r} 35 \\ 15 \\ \hline \end{array}$	$\begin{array}{r} 45 \\ 29 \\ \hline \end{array}$	$\begin{array}{r} 55 \\ 37 \\ \hline \end{array}$	$\begin{array}{r} 65 \\ 28 \\ \hline \end{array}$
6.	$\begin{array}{r} 86 \\ 37 \\ \hline \end{array}$	$\begin{array}{r} 96 \\ 58 \\ \hline \end{array}$	$\begin{array}{r} 36 \\ 19 \\ \hline \end{array}$	$\begin{array}{r} 46 \\ 27 \\ \hline \end{array}$	$\begin{array}{r} 56 \\ 38 \\ \hline \end{array}$	$\begin{array}{r} 66 \\ 29 \\ \hline \end{array}$	$\begin{array}{r} 76 \\ 35 \\ \hline \end{array}$
7.	$\begin{array}{r} 97 \\ 38 \\ \hline \end{array}$	$\begin{array}{r} 38 \\ 19 \\ \hline \end{array}$	$\begin{array}{r} 47 \\ 35 \\ \hline \end{array}$	$\begin{array}{r} 57 \\ 29 \\ \hline \end{array}$	$\begin{array}{r} 67 \\ 24 \\ \hline \end{array}$	$\begin{array}{r} 77 \\ 39 \\ \hline \end{array}$	$\begin{array}{r} 87 \\ 48 \\ \hline \end{array}$
8.	$\begin{array}{r} 37 \\ 18 \\ \hline \end{array}$	$\begin{array}{r} 48 \\ 19 \\ \hline \end{array}$	$\begin{array}{r} 58 \\ 26 \\ \hline \end{array}$	$\begin{array}{r} 68 \\ 34 \\ \hline \end{array}$	$\begin{array}{r} 78 \\ 22 \\ \hline \end{array}$	$\begin{array}{r} 88 \\ 29 \\ \hline \end{array}$	$\begin{array}{r} 98 \\ 31 \\ \hline \end{array}$
9.	$\begin{array}{r} 49 \\ 17 \\ \hline \end{array}$	$\begin{array}{r} 39 \\ 28 \\ \hline \end{array}$	$\begin{array}{r} 69 \\ 38 \\ \hline \end{array}$	$\begin{array}{r} 79 \\ 48 \\ \hline \end{array}$	$\begin{array}{r} 89 \\ 28 \\ \hline \end{array}$	$\begin{array}{r} 99 \\ 35 \\ \hline \end{array}$	$\begin{array}{r} 39 \\ 18 \\ \hline \end{array}$

NOTE.—The foregoing questions may be solved as follows: *e.g.* $48 - 29$. Forty-eight is 3. and 18; twenty-nine is twenty and nine. Therefore, the difference is $30 - 20 + 18 - 9$, which is $10 + 9$, or 19. This question may also be solved by asking, What shall we put with 29 to make 48? thus changing it into a question of addition.

Exercise 12

1. A man having 17 dollars paid 9 dollars for flour. How much money had he left?

2. I bought a plough for 24 dollars and sold it for 17 dollars. What did I lose? Had I sold it for 31 dollars, what would I have gained?

3. The sum of two numbers is 27; one of them is 13. Find the other.

4. What number must be added to the sum of 18 and 13 to make 50?

5. The sum of three numbers is 67, the smallest is 12, the greatest is 14 more than this. Find the third number.

6. $9 + 3 - 8 + 7 - 5 + 4 - 3 + 11 - 9 + 7 - 2 + 13 - 9 + 12 - 13 + 17 - 3$ is how many?

7. From the sum of 9, 8, and 6 take the difference between 11 and 17.

8. Take the sum of 9, 6, 7, 4, and 5 from the sum of 5, 11, 13, and 7.

9. A drover bought 60 sheep of three farmers. He bought 18 of the first and 16 of the second. How many did he buy of the third?

10. Willie goes up 3 steps of a ladder that has 27 steps, then down 2, then up 5, then down 4, then up 7, then down 3, then up 9. What step from the top and bottom does he stand upon?

11. Two men set out from two places 91 miles apart and travel to meet each other. At the end of the first day one

has travelled 45 miles and the other 37 miles. How far are they apart? How far is each from the starting-point of the other?

12. A man earns 75 dollars a month. If it costs him 29 dollars for board and 37 dollars for clothing and other expenses, how much can he save?

13. From a basket containing one peck, one gallon, and 5 quarts of oats, 9 quarts were taken. How much was left? Give your answer in quarts.

14. The difference between two numbers is 13. One of the numbers is 25. Find the other.

15. A crock with the butter in it weighs 24 pounds 8 ounces. The crock alone weighs 7 pounds and 12 ounces. How much butter did it contain?

Exercise 13

- | | | | |
|---------------------|------------------|------------------|------------------|
| 1. $3 \times 8 = ?$ | $6 \times 4 = ?$ | $8 \times 7 = ?$ | $6 \times 3 = ?$ |
| $4 \times 5 = ?$ | $3 \times 9 = ?$ | $4 \times 9 = ?$ | $8 \times 4 = ?$ |
| $9 \times 6 = ?$ | $5 \times 7 = ?$ | $3 \times 4 = ?$ | $2 \times 8 = ?$ |
| $7 \times 8 = ?$ | $2 \times 9 = ?$ | $9 \times 2 = ?$ | $5 \times 3 = ?$ |
| $2 \times 9 = ?$ | $6 \times 9 = ?$ | $7 \times 6 = ?$ | $4 \times 8 = ?$ |
| 2. $3 \times 5 = ?$ | $5 \times 2 = ?$ | $4 \times 2 = ?$ | $7 \times 4 = ?$ |
| $9 \times 7 = ?$ | $2 \times 4 = ?$ | $9 \times 5 = ?$ | $6 \times 5 = ?$ |
| $7 \times 3 = ?$ | $4 \times 3 = ?$ | $2 \times 6 = ?$ | $8 \times 3 = ?$ |
| $8 \times 2 = ?$ | $5 \times 8 = ?$ | $8 \times 8 = ?$ | $4 \times 6 = ?$ |
| $9 \times 3 = ?$ | $3 \times 7 = ?$ | $8 \times 6 = ?$ | $9 \times 9 = ?$ |
| 3. $3 \times 6 = ?$ | $4 \times 4 = ?$ | $7 \times 5 = ?$ | $6 \times 7 = ?$ |
| $2 \times 5 = ?$ | $3 \times 3 = ?$ | $6 \times 8 = ?$ | $8 \times 9 = ?$ |
| $7 \times 7 = ?$ | $9 \times 8 = ?$ | $5 \times 9 = ?$ | $5 \times 6 = ?$ |
| $6 \times 6 = ?$ | $6 \times 2 = ?$ | $9 \times 4 = ?$ | $4 \times 7 = ?$ |
| $5 \times 5 = ?$ | $8 \times 5 = ?$ | $7 \times 9 = ?$ | $5 \times 4 = ?$ |

Read and complete :

4. $12 = 4 \times ?$ $35 = 7 \times ?$ $54 = 9 \times ?$ $42 = 7 \times ?$
 $20 = 5 \times ?$ $18 = 6 \times ?$ $45 = 9 \times ?$ $32 = 8 \times ?$
 $14 = 7 \times ?$ $21 = 3 \times ?$ $28 = 7 \times ?$ $40 = 8 \times ?$
 $30 = 6 \times ?$ $36 = 9 \times ?$ $56 = 8 \times ?$ $72 = 9 \times ?$
 $24 = 6 \times ?$ $48 = 8 \times ?$ $27 = 9 \times ?$ $63 = 9 \times ?$
5. $16 = 8 \times ?$ $64 = 8 \times ?$ $90 = 9 \times ?$ $18 = 3 \times ?$
 $40 = 10 \times ?$ $21 = 3 \times ?$ $80 = 10 \times ?$ $50 = 5 \times ?$
 $36 = 6 \times ?$ $70 = 10 \times ?$ $35 = 5 \times ?$ $70 = 10 \times ?$
 $28 = 4 \times ?$ $12 = 3 \times ?$ $80 = 8 \times ?$ $30 = 3 \times ?$
 $60 = 6 \times ?$ $20 = 4 \times ?$ $14 = 2 \times ?$ $16 = 4 \times ?$
6. $24 = 4 \times ?$ $45 = 5 \times ?$ $80 = 16 \times ?$ $96 = 16 \times ?$
 $36 = 4 \times ?$ $40 = 5 \times ?$ $81 = 9 \times ?$ $72 = 18 \times ?$
 $54 = 6 \times ?$ $90 = 15 \times ?$ $63 = 7 \times ?$ $60 = 12 \times ?$
 $32 = 4 \times ?$ $48 = 6 \times ?$ $56 = 7 \times ?$ $42 = 6 \times ?$
 $70 = 14 \times ?$ $72 = 8 \times ?$ $39 = 13 \times ?$ $33 = 11 \times ?$

7. Find the following results :

- $12 \times 3 = ?$ $14 \times 5 = ?$ $35 \times 2 = ?$ $23 \times 2 = ?$
 $15 \times 6 = ?$ $26 \times 3 = ?$ $27 \times 3 = ?$ $25 \times 3 = ?$
 $21 \times 4 = ?$ $16 \times 4 = ?$ $18 \times 5 = ?$ $28 \times 2 = ?$
 $32 \times 2 = ?$ $19 \times 3 = ?$ $24 \times 4 = ?$ $31 \times 3 = ?$

8. To 13 add 7, take away 5, multiply by 2, take away 15, take away 10, multiply by 3, and take away 5.

9. 29 add 11, double, take away 16, and add 6.

10. 7 add 8, triple, add 5, half, add 14, and take away 19

Exercise 14

1. I paid 4 dollars a day for a team and kept it 11 days. What did it cost me?

2. Find the total cost of 5 cords of wood at 6 dollars a cord and 3 tons of coal at 12 dollars a ton.

3. How much greater is 9×8 than 6×9 ?
4. A farmer sold 8 sheep at 5 dollars each and 7 pigs at 6 dollars each. How much did he receive in all?
5. A man earns 23 dollars a month. He spends 18 dollars a month. How much does he save in a year?
6. A merchant has 43 yards of tweed. If he sells 24 yards of it, what will the remainder be worth at 3 dollars a yard?
7. If 6 men can dig a ditch in 8 days, how long will it take one man to dig the ditch?
8. If two men set out from the same village and travel in opposite directions, the one at the rate of 3 miles an hour and the other at the rate of 4 miles an hour, how far will they be apart in 9 hours?
9. For how much must I sell 8 barrels of fish which cost me 6 dollars a barrel, so as to gain 13 dollars? so as to lose 9 dollars?
10. I bought 4 cords of wood at 7 dollars a cord, and gave in payment six 5-dollar bills. How much change should I receive?
11. A man bought a horse for 48 dollars, paid 3 dollars a week for his expenses, and received 5 dollars a week for his work. At the end of 8 weeks he sold him for 60 dollars. How much did he gain or lose?
12. How much tea will it take to fill 8 cans, each holding 24 ounces of tea?
13. If it takes 7 yards 2 feet of cloth to make one suit of clothes, how much will be required for 5 suits?
14. A boy earns 3 dollars a day and spends 2 dollars a day. How much can he save in the month of June, there being four days during which he does not work?

Exercise 15

Read and complete:

- | | | | | |
|----|------------------|------------------|------------------|------------------|
| 1. | $16 \div 4 = ?$ | $14 \div 7 = ?$ | $20 \div 5 = ?$ | $36 \div 9 = ?$ |
| | $36 \div 6 = ?$ | $24 \div 6 = ?$ | $35 \div 7 = ?$ | $54 \div 9 = ?$ |
| | $64 \div 8 = ?$ | $28 \div 7 = ?$ | $30 \div 6 = ?$ | $48 \div 8 = ?$ |
| | $12 \div 4 = ?$ | $21 \div 7 = ?$ | $18 \div 6 = ?$ | $45 \div 9 = ?$ |
| 2. | $56 \div 8 = ?$ | $40 \div 8 = ?$ | $40 \div 10 = ?$ | $80 \div 10 = ?$ |
| | $27 \div 9 = ?$ | $72 \div 9 = ?$ | $60 \div 6 = ?$ | $50 \div 5 = ?$ |
| | $42 \div 7 = ?$ | $63 \div 9 = ?$ | $90 \div 10 = ?$ | $25 \div 5 = ?$ |
| | $32 \div 8 = ?$ | $16 \div 8 = ?$ | $70 \div 7 = ?$ | $49 \div 7 = ?$ |
| 3. | $81 \div 9 = ?$ | $28 \div 4 = ?$ | $30 \div 5 = ?$ | $48 \div 6 = ?$ |
| | $12 \div 6 = ?$ | $21 \div 3 = ?$ | $18 \div 3 = ?$ | $45 \div 5 = ?$ |
| | $14 \div 2 = ?$ | $20 \div 4 = ?$ | $36 \div 4 = ?$ | $56 \div 7 = ?$ |
| | $24 \div 3 = ?$ | $35 \div 5 = ?$ | $54 \div 6 = ?$ | $27 \div 3 = ?$ |
| 4. | $20 \div 6 = ?$ | $28 \div 8 = ?$ | $36 \div 7 = ?$ | $44 \div 11 = ?$ |
| | $22 \div 8 = ?$ | $30 \div 7 = ?$ | $38 \div 6 = ?$ | $46 \div 2 = ?$ |
| | $24 \div 7 = ?$ | $32 \div 5 = ?$ | $40 \div 3 = ?$ | $48 \div 7 = ?$ |
| | $26 \div 4 = ?$ | $34 \div 9 = ?$ | $42 \div 9 = ?$ | $50 \div 9 = ?$ |
| 5. | $52 \div 3 = ?$ | $60 \div 12 = ?$ | $68 \div 2 = ?$ | $76 \div 4 = ?$ |
| | $54 \div 7 = ?$ | $62 \div 2 = ?$ | $70 \div 5 = ?$ | $78 \div 6 = ?$ |
| | $56 \div 5 = ?$ | $64 \div 9 = ?$ | $72 \div 8 = ?$ | $80 \div 9 = ?$ |
| | $58 \div 11 = ?$ | $66 \div 6 = ?$ | $74 \div 3 = ?$ | $82 \div 2 = ?$ |
| 6. | $84 \div 7 = ?$ | $23 \div 8 = ?$ | $39 \div 3 = ?$ | $49 \div 9 = ?$ |
| | $86 \div 2 = ?$ | $29 \div 7 = ?$ | $41 \div 5 = ?$ | $53 \div 2 = ?$ |
| | $88 \div 11 = ?$ | $31 \div 8 = ?$ | $45 \div 8 = ?$ | $57 \div 3 = ?$ |
| | $90 \div 15 = ?$ | $37 \div 9 = ?$ | $47 \div 6 = ?$ | $61 \div 4 = ?$ |

Exercise 16

1. A horse trotted 48 miles in 6 hours. How many miles an hour did he average?

2. A carpenter earns 12 dollars a week. In what time will he earn 72 dollars?
3. One man can do a piece of work in 56 days. In what time could 8 men do this work?
4. How much will 75 yards of cloth cost at the rate of 10 yards for one dollar?
5. Three times a number added to four times the same number is 36. Find the number.
6. What number must you take from 85 so that the remainder may be exactly divisible by 8?
7. What number must you add to 32 so that it may be exactly divisible by 7?
8. What number subtracted 7 times from 59 leaves a remainder 3?
9. Tom had 7 cents and James 4 cents. What part of all the money belongs to Tom? What part to James?
10. When wheat was sold at the rate of 6 bushels for 12 dollars, how many bushels would be given in exchange for 6 cords of wood at 6 dollars a cord?
11. A boat can run 8 miles an hour down a river and 6 miles an hour against the current. After running down stream for 4 hours, how long will it take in returning?
12. Twenty-five apples were divided between two boys so that one had 7 apples more than the other. How many apples had each?
13. Charlie had 3 cents and Willie 4 cents; they put this money together and bought 21 marbles. How should the marbles be divided?
14. Which years are leap years? Which of the months have 31 days? How many days are there in the seventh month? in the fourth month?
15. How many months and days are there from the 5th of January, 1904, to the 10th of September of the same year?

16. How many pint bottles will be needed to hold 2 gallons 3 quarts of maple syrup?

17. A sold B one peck of raspberries at 3 cents a pint, and received in payment 3 gallons of strawberries at 10 cents a quart. Who pays the difference and how much?

18. A garden is 32 feet long and 20 feet wide. How long will the fence be that encloses it?

19. How far will a train, moving 6 miles in 15 minutes, move in two hours, if it makes one stop of half an hour?

20. Tom owes William \$25.30, and gives him on account \$18.50. If he pays the balance with a ten-dollar bill, how much change should he receive?

21. I bought 40 turkeys at the rate of 10 turkeys for 6 dollars, and sold them at the rate of 5 turkeys for 4 dollars. Find my gain or loss.

22. How many pounds of sugar at 7 cents a pound can be bought for 3 twenty-five-cent pieces and a ten-cent piece?

23. A farmer sold a cow for 43 dollars and 23 bushels of wheat for 17 dollars. He was paid in 4-dollar bills. How many bills did he get?

24. $\frac{1}{3}$ of 64 dollars is 7 times as much money as I have. How much have I?

25. In $\frac{2}{3}$ of a yard of cloth cost 20 cents, find what $\frac{5}{6}$ of a yard of the same cloth would cost.

26. A man bought some apples for 44 cents at the rate of 5 apples for 11 cents. He divided the purchase equally among his 4 children. How many did each receive?

27. A teacher, being asked how many scholars he had, said that there were 30 boys and $\frac{1}{5}$ of this number less 8 were girls. How many scholars were there?

28. Which is the cheaper, a hat that costs 90 cents and lasts 6 months, or one that costs 80 cents and lasts 5 months? What is saved in a year by wearing the cheaper hat?

29. How many flowers can be planted along the border of a flower-bed 6 feet long and 4 feet wide, the plants being placed 6 inches apart?

30. There are 72 coins in a bag. $\frac{2}{9}$ are ten-cent pieces, $\frac{1}{4}$ are half-dollars, and the remainder are quarters. How many of each are there?

31. How do you find the number of eights in 63, the number of sixes in 100, and the number of sevens in 59?

32. If you knew the number of acres a farmer had in wheat and the yield per acre, what could you find?

33. If you knew the number of bushels of wheat a farmer had for sale and also the price he received per bushel, what could you find?

34. If you were asked to build a 4-inch cube of blocks each an inch cube, could you tell how many of the smaller cubes you would require without having actually to build the cube? How?

NOTATION AND NUMERATION

When we count more than nine, we begin to count by *tens and ones*. After nine we say *ten, one and ten* or eleven, *two and ten* or twelve, *three and ten* or thirteen, *four and ten* or fourteen, *five and ten* or fifteen, *six and ten* or sixteen, *seven and ten* or seventeen, *eight and ten* or eighteen, *nine and ten* or nineteen, *two tens* or twenty, and so on until we reach *nine tens and nine* or ninety-nine.

Instead of writing these numbers in words we make use of the figures, or *digits*, 1, 2, 3, 4, 5, 6, 7, 8, 9, and the cipher, 0. These we may arrange to represent any number, however large, just as we may place the few letters of our alphabet so as to represent the longest and most difficult word of our language. Thus we can tell whether a digit stands for *ones*

or *tens* by the place it occupies. If it represents *ones*, it has the first place at the right; if *tens*, it has the next place on the left. The right-hand place is therefore the *ones*' place, and the next place to the left is the *tens*' place.

If we count one more than ninety-nine, we shall have *ten tens*, or *one hundred*, to represent which we write *one* in the *third place* and fill the *tens*' and *ones*' places with ciphers, thus: 100. A digit in the third place from the right always stands for *hundreds*, and hence we write: 200 (two hundred), 900 (nine hundred), and so on.

If with the hundreds we wish to write any number of tens or ones, we place the digit representing the tens in the *tens*' place and the digit representing the ones, or *units*, in the *ones*' place. Thus, *three hundred and seventy-five* is written, *three hundreds, seven tens, and five ones*, thus: 375.

Exercise 17

1. How many tens are there in twenty-seven, sixty-two, ninety, thirty-three, fifty-eight, eighty-four?
2. Read as *tens* and *ones*: 67, 55, 40, 83, 11, and 49.
3. The number 48 is represented by two digits. What does the 8 stand for? the 4? Interchange the 8 and the 4, and state what each will stand for in its new place. Which digit in 48 expresses the greater value? Why?
4. Express in words: 691, 728, 530, 903, 117, 888, and 500.
5. How many *hundreds* in 673? how many *tens*? how many *ones*?
6. Read the following numbers as *hundreds, tens, and ones*: 853, 160, 749, 317, and 202.
7. In any number of three places, what figure is read first? Which figure represents the highest *order*, or place? What would be wrong in leaving the *ones* place in 160 and the *tens*' place in 202 vacant?

8. Write all the numbers of three figures in which the two left-hand figures are *eight* and *five*; in which the two right-hand figures are *six* and *zero*.

9. Write the greatest and the least number made up of the three figures 9, 1, 3.

10. Write all the numbers possible from the figures *three*, *four*, and *five*.

The greatest three-figure number we can write is nine hundred and ninety-nine. The number above this is *ten hundred*, or *one thousand*. To represent one thousand in figures we write *one* in the *fourth place* and fill the places of the hundreds, tens, and *ones* with zeros, thus: 1000. A digit in the fourth place always stands for *thousands*, and we therefore write: 2000 (two thousand), 7000 (seven thousand), etc.

If with the thousands we wish to write hundreds, tens, units, we have only to do what we have done before, namely, to place the digit representing the hundreds in the third or hundreds' place, that representing the tens in the second or tens' place, and that representing the units or ones in the ones' or units' place. Following this plan, we write *seven thousand four hundred and thirty-six* (7436), making the thousands take the fourth place in order, the hundreds the third place, the tens the second place, and the ones the first place.

We have now learned the names of the orders to thousands. We have also learned that ten of one order make one of the next higher order, and that the order of a figure, that is, whether it represents units, tens, hundreds, or thousands, is known by the place which it occupies, numbering always from the right.

When we reach *thousands* we begin to count as we did in ones, namely, one thousand, two thousand, three, four, five, etc., thousand, up to *nine hundred and ninety-nine thousand*, and when we have a *thousand thousand*, we call the number

one million. Millions we count in the same way as *ones* and *thousands*, namely, up to *nine hundred and ninety-nine millions*.

Now just as we avoid writing the words *units*, *tens*, and *hundreds*, by giving to each order its place, so we avoid writing the word *thousand* by giving *thousands* the *three places to the left of hundreds*. In the same way we give *millions* the *three places to the left of thousands*. In this way, it comes that when more figures than three figures are employed to represent a number, they are divided into groups, the first of which, numbering from the right, is used to express any number from one to nine hundred and ninety-nine; the second, from one to nine hundred and ninety-nine thousand; the third from one to nine hundred and ninety-nine millions, etc. These groups are called *periods*, and for ease in reading are sometimes separated from each other by commas. Thus, beginning from the right, we have the first period, of *ones, tens, and hundreds of units*; the second period of *ones, tens, and hundreds of thousands*; the third period of *ones, tens, and hundreds of millions*, etc. The following plan will make this plain:

PLAN OF ENUMERATION

	Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones
1.				7	4		3	6	5
2.				9	0	6	2	0	8
3.			3	4	2	0	7	6	8
4.		5	6	0	0	7	9	2	1
5.	8	2	4	7	7	7	6	6	5
	⏟			⏟			⏟		
	MILLIONS			THOUSANDS			ONES		

Exercise 18

1. Read these numbers : 7825, 9009, 7708, 3021, and 4000.
 2. What is the smallest number that can be represented by four figures ? What is the greatest ?
 3. Write the greatest and the least numbers that can be formed by using five figures ; by using nine figures.
 4. Write, in order, all the numbers of four figures that can be formed having 5 for the left-hand figure and 89 for the two right-hand figures. Read the numbers written.
 5. Write in figures: three hundred and sixty-nine thousand, four hundred and thirty-one; two hundred thousand and two; seventy-five millions, twenty-six thousand and ninety; eight thousand and fifty-six.
 6. What number is expressed by the figure 7 in 8007 ? in 7008 ? in 6070 ?
 7. Read the following numbers :

23,600	214,310	3,414,218
80,027	161,002	70,023,925
75,681	300,010	623,428,999
46,300	573,493	901,000,109
- Why are commas used in question 7 ?
8. Write the numbers next above 23999, 99999, 777889, 79909.
 9. Write the numbers next below 200001, 80000, 30590, and 323999.
 10. How many hundreds are there in 78 tens, 168 tens, and 1000 tens ? How many ones in 4 tens, and in 13 tens ? How many thousands and hundreds in 63 hundreds and in 420 tens ?
 11. Read the following, D representing 500 and M 1000 : DCCCLIX, CDXL, CMI, MCL, CCCIV, MMDIV, MCMIV.
 12. Write in Roman numerals : 960, 1299, 1904, 3333.

ADDITION

Were you to find the *sum* of 27 and 58, you would perhaps proceed as follows: 27 is 2 tens and 7 ones; 58 is 5 tens and 8 ones. Therefore 27 and 58 make 7 tens and 15 ones or 8 tens and 5 or 85. This is an excellent method were you working this question *orally*, but if you were permitted to use blackboard, slate, or exercise book, you would place the numbers so that the eye could take in their meaning at a glance. Addition questions are therefore usually placed as in *a* or *b*:

$$a \quad 27 + 58 = ?$$

$$b \quad \begin{array}{r} 27 \\ 58 \\ \hline ? \end{array}$$

For small numbers like those given above, it may be easier to work from the *left to the right* as you have done, but in the larger and more difficult questions, people have found working from the *right to the left* much more satisfactory. Let us see how this is done in the following example:

Add together 725, 839, 787, and 666.

In this example we are to add:

7 hundreds + 2 tens + 5 ones

8 hundreds + 3 tens + 9 ones

7 hundreds + 8 tens + 7 ones

6 hundreds + 6 tens + 6 ones

30 hundreds + 1 ten + 7 ones

Commencing with the *ones' column*, that is at the right, we obtain 27 ones, 19 tens, and 28 hundreds. This is right, no doubt, but we never have more than 9 of any order in a number. Instead of having 27 ones under the ones' column, we say 27 ones is 2 tens and 7 ones, and we place the 7 under

the ones and add or carry the 2 tens to the tens' column; 19 tens and 2 tens make 21 tens or two hundreds and one ten; the one ten we place under the tens' column, and the two hundreds we carry forward to add to the hundreds of the hundreds' column. 2 hundreds and 28 hundreds make 30 hundreds which we set down under the hundreds' column. Our sum now reads 30 hundreds, 1 ten, and 7 ones, or 3 thousand and seventeen which, we know, can be written at once 3017.

The foregoing example has been worked out very fully in order to assist in reaching the method. In actual work we would set down the addends as follows:

$$\begin{array}{r}
 725 \\
 839 \\
 787 \\
 666 \\
 \hline
 3017
 \end{array}$$

Add together:

Exercise 19

1.	2.	3.	4.	5.	6.	7.	8.
37	29	68	29	53	96	36	20
28	36	34	27	67	45	17	30
64	45	92	68	85	51	85	40
<u>47</u>	<u>76</u>	<u>46</u>	<u>37</u>	<u>38</u>	<u>38</u>	<u>24</u>	<u>50</u>
9.	10.	11.	12.	13.	14.	15.	16.
639	452	984	547	738	735	246	153
428	900	213	163	524	736	749	757
373	173	457	298	337	507	293	999
346	289	120	207	387	289	135	211
<u>218</u>	<u>361</u>	<u>427</u>	<u>357</u>	<u>862</u>	<u>779</u>	<u>700</u>	<u>877</u>

17.	18.	19.	20.	21.	22.	23.
2483	3391	4001	5544	6172	4444	9999
1756	7267	5000	5544	8733	7887	8888
1937	9385	7778	4455	4633	9351	7777
4448	7489	9889	7733	7249	6427	6556
5596	3399	3324	6666	3856	3878	8448

24.	25.	26.	27.	28.
16566	24030	305129	140757	175324
24656	33246	224603	265075	477353
32562	21438	145234	344123	720277
45672	45546	242456	534522	545633
32345	37408	560347	754321	463647
16606	16165	200500	261231	255364

NOTE.—Prove the foregoing results by adding the columns downwards as well as upwards.

Exercise 20

Add together:

1	2	3	4
\$ 74.08	\$ 317.75	\$ 214.98	\$ 28165
7.35	21.13	31.17	41412
52.73	4208.30	1023.84	175557
428.19	7.28	1116.21	250870
87.65	2175.85	311.15	182737
386.05	16.17	91.78	457019
.65	348.25	4235.67	6118
17.14	5649.38	23.18	3027

NOTE.—In writing sums of money to add, the dollar sign is written but twice, viz., before the first number and before the answer.

5. Add in columns and in lines:

	A	B	C	D	E	F	TOTALS M
1	379	698	846	111	842	798	
2	426	476	798	555	267	197	
3	545	979	832	706	981	336	
4	684	262	198	108	80	322	
5	291	947	164	980	187	227	
6	799	698	621	16	134	554	
7	138	843	268	484	832	944	
8	231	290	800	108	698	492	
9	679	122	697	9	347	167	
10	800	984	628	132	649	376	
11	189	432	641	806	798	178	
12	294	901	984	724	416	316	
13	175	229	962	800	214	813	
TOTALS N							

Find the sum of Totals M and the sum of Totals N.

Exercise 21

Find the sum of:

1. $7462 + 3783 + 6334 + 8544 + 659 + 7648.$
2. $4389 + 7856 + 7262 + 7938 + 5487 + 3965.$
3. $1819 + 9753 + 8294 + 9631 + 29 + 9475.$
4. $3456 + 7891 + 2345 + 8705 + 3497 + 2879.$
5. $7777 + 6666 + 3939 + 2008 + 9495 + 3763.$
6. $9449 + 8558 + 6776 + 5665 + 4884 + 3773.$
7. $2008 + 9988 + 7766 + 6378 + 7049 + 2468.$
8. $7245 + 39 + 8 + 7206 + 945 + 8397.$
9. $1379 + 8674 + 5647 + 4786 + 3895 + 9876.$
10. $\$432.17 + \$73.58 + \$694.35 + \$97.87 + \$603.05.$

11. Add downwards and across :

648	617	485	597	947
139	418	574	618	679
1074	1479	643	478	536
372	839	8272	637	276
826	4756	4181	885	823
457	321	745	964	899
<u>2791</u>	<u>789</u>	<u>486</u>	<u>738</u>	<u>1748</u>

12. Add :

17 lb. 12 oz.	5 ft. 7 in.	18 bu. 2 pk.
13 lb. 4 oz.	8 ft. 9 in.	7 bu. 3 pk.

13. Add :

6 gal. 3 qt.	17 da. 14 hr.	5 da. 3 hr.
4 gal. 2 qt.	9 da. 18 hr.	2 da. 9 hr.

14. Add : Forty-seven thousand six hundred and twenty, seven thousand four hundred and fifty-five, two hundred and forty-four thousand one hundred and sixty-one, fifty-seven hundred and eleven, one hundred and nine thousand eight hundred and one, and eleven million thirty thousand five hundred and five.

Exercise 22

1. What length of fencing will be necessary to enclose a lot, the four sides of which are 132 feet, 332 feet, 126 feet, and 189 feet?

2. A man paid 175 dollars for a carriage, 165 dollars for a horse, 25 dollars for harness, 7 dollars for a robe, and 3 dollars for a whip. Find the cost of the whole outfit.

3. How many days are there in the year 1904, there being 7 months of 31 days each, 4 months of 30 days each, and one month of 29 days?

4. I sold a farm for \$7468 and lost \$1724. What did my farm cost me at first?

5. The population of a town was 1627; the next year it gained 540; the second year, 873; the third year, 426; and the fourth year, 1289. What was its population at the end of the four years?

6. A farmer sold 897 bushels of wheat from one farm, 673 from a second, and 3845 from a third. How much wheat did the farmer sell?

7. The first of four numbers is 5178, the second is greater than the first by 473, the third is equal to the sum of the first and second, and the fourth is equal to the sum of the second and third. Find the sum of the four numbers.

8. Find the sum of the five largest numbers that can be expressed by the figures 6, 7, 8, and 9.

9. Find the total number of letters, cards, etc., posted at the Victoria post-office during the week if the following statement is correct:

	MON.	TUES.	WED.	THURS.	FRI.	SAT.	TOTAL
Ordinary letters	9423	8654	9777	5687	9768	8788	
Registered letters	569	728	866	675	787	875	
Postal cards	3420	1422	2587	4381	1893	4368	
Book packets	384	275	327	567	260	429	
Parcels	212	317	185	438	197	265	
Newspapers	12375	11358	15967	13258	14386	18278	
TOTAL							

10. The first three cars of a freight train contain 35,240 pounds each; the next four cars, 25,345 pounds each; the next two cars, 31,540 pounds each; and the last car, 25,432 pounds. How many pounds of freight in the ten cars?

Exercise 23

1. An American farmer wishing to move to Canada, sold his 2 horses at \$146 each, his oxen for \$98, his sheep for \$136, his pigs for \$85, and his poultry for \$18.65. How much did he get in all for the sale of his stock?
2. On May the 7th, Mr. Brown had only \$861.75 in the Imperial Bank, but in the course of the day he deposited \$211 in bills and \$743.35 in checks. How much had he then in the bank?
3. In going into business, Mr. Brown invested \$8375, Mr. Jones \$4216 more than Mr. Brown, and Mr. Robinson \$786 more than both. Find the total capital put into the business.
4. The school trustees in a western town built a school-house costing as follows: digging the cellar, \$575; foundation, \$2689; brickwork, \$17,895; roofing, \$7875.65; plastering, \$5618; woodwork, \$10,489; painting, etc., \$3275. Find the total cost if the furnishings and extras cost \$2865.
5. In the province of Manitoba there was manufactured 987,007 pounds of cheese valued at \$83,896 in 1897; 800,084 pounds valued at \$69,367 in 1898; 848,587 pounds valued at \$86,980 in 1899; 1,021,258 pounds valued at \$102,330 in 1900; 1,039,392 pounds valued at \$88,348 in 1901; and 1,093,653 pounds valued at \$111,443 in 1902. Find the total weight of cheese manufactured in Manitoba during the years given and the total value of the same.
6. Find from the following statements (a) the total wheat acreage and total wheat yield for the five years; (b) the total acreage in oats and total yield for the five years; and (c) the total acreage given to barley and the total yield in barley for the same time:

CROP RETURNS OF NORTH-WEST TERRITORIES, 1898-1902

	WHEAT		OATS		BARLEY	
	Acres	Bushels	Acres	Bushels	Acres	Bushels
1898	307,580	5,542,478	105,077	3,040,307	17,092	449,512
1899	363,524	6,915,623	134,938	4,686,036	14,276	337,521
1900	412,864	4,028,294	175,139	4,226,152	17,044	353,216
1901	501,697	12,808,447	229,139	11,113,066	24,702	795,100
1902	625,758	13,956,850	310,367	10,661,295	36,445	870,417

7.

	1901		1891	
	Males	Females	Males	Females
Canada	2,751,708	2,619,607	2,460,471	2,372,768
British Columbia . .	114,160	64,497	63,003	35,170
Manitoba	138,504	116,707	84,342	68,164
New Brunswick . . .	168,639	162,481	163,739	157,524
Nova Scotia	233,642	225,932	227,093	223,303
Ontario	1,096,640	1,086,307	1,069,487	1,044,834
Prince Edward Island .	51,959	51,300	54,881	54,197
Quebec	824,454	824,444	744,141	744,394
North-West Territories				
Alberta	36,886	28,990	14,649	10,628
Assiniboia	37,302	30,083	17,184	13,188
Saskatchewan . .	13,250	12,429	5,793	5,357
Unorganized . . .	36,272	16,437	16,159	16,009

The foregoing is a statement of the population of Canada during the years 1901 and 1891. Find:

- (a) The total male population during 1891.
- (b) The total female population during 1891.
- (c) The total male population during 1901.
- (d) The total female population during 1901.

(e) The total male population in the North-West Territories for 1891.

(f) The total female population in the North-West Territories for 1891.

(g) The total male population in the North-West Territories for 1901.

(h) The total female population in the North-West Territories for 1901.

(i) The total population in Canada for 1891.

(j) The total population in Canada for 1901.

8.		Pounds		Pounds
Whitefish	10,546,600	Catfish	550,000	
Trout	101,700	Mixed and coarse fish .	5,558,000	
Pickrel	5,270,900	Caviare (the roe of the		
Pike	4,208,300	sturgeon)	20,000	
Sturgeon	727,600	Gold-eyes	200,000	
Perch	34,000	Home consumption . .	738,600	
Tullibee	926,000			

During the year 1901, the fish catch in the lakes and rivers of the Canadian West was as above stated. Find the total weight of fish caught.

9. The following is a statement of the number of skins sold at London, England, in 1887, by the Hudson's Bay Company and by Lampson & Co. Find the total number.

Otter	14,439	Muskrat	2,485,368
Sea otter	3,868	Extra black muskrat . .	13,944
Fisher	7,192	Wolf	7,156
Silver fox	1,967	Wolverene	1,581
Cross fox	6,785	Bear (all kinds)	15,942
Red fox	85,022	Musk-ox	198
White fox	10,257	Badger	3,739
Kitt fox	290	Ermine	4,116
Lynx	14,520	Swan	57
Skunk	632,794	American rabbit	114,824
Marten	98,342	Hair seal (dry)	13,478
Mink	376,223	Sable	3,517
Beaver	104,279	Gray fox	31,597

10. At 6 o'clock, January 2d, the common thermometer registered 13° below zero. How much below the freezing-point of water was the temperature?

11. What is the difference between 40° below zero and 68° above zero? Between 13° below zero and 12° above the freezing-point of water?

SUBTRACTION

Were you asked to take 18 from 53, you would probably work as follows :

53 is 5 *tens* and 3 *ones*

18 is 1 *ten* and 8 *ones*

As we cannot take 8 ones from 3 ones, we shall have to rearrange the 5 tens and 3 ones, so as to read 4 tens and 13 ones. In other words, we shall have to take a ten from the 5 tens, and add it to the 3 ones. The question with this change will now read :

From 4 *tens* and 13 *ones*

Take 1 *ten* and 8 *ones*

which leaves 3 *tens* and 5 *ones* or 35, the *difference* or *remainder*.

Again, if we wished to take 724 from 896, we would place these numbers so that the units would be under the units, the tens under tens, and the hundreds under the hundreds, thus :

8 *hundreds* + 9 *tens* + 6 *units*, or *ones*

7 *hundreds* + 2 *tens* + 4 *units*, or *ones*

We would next take the units of the *subtrahend* or *number to be subtracted*, from the units of the *minuend*, or *number to be diminished*, the tens from the tens and the hundreds from the hundreds. As the tens' figure and the units' figure of the

minuend are greater than the tens' figure and the units' figure of the subtrahend, no change in the minuend is necessary, and the difference is at once written 1 hundred + 7 tens + 2 units or 172.

Were all questions in subtraction like the foregoing, there would be no difficulty. We shall therefore have to consider a case when some rearrangement must be made before the question can be readily solved. The following problem is a good example :

From 8735 take 4896

Written in full this will read :

From 8 thousands + 7 hundreds + 3 tens + 5 units

Take 4 thousands + 8 hundreds + 9 tens + 6 units

Examining these numbers we at once see that the 6 units cannot be taken from the 5 units, the 9 tens from the 3 tens, nor the 8 hundreds from the 7 hundreds. Taking a *ten* from the 3 tens and adding it to the 5 units, our question will read :

From 8 thousands + 7 hundreds + 2 tens + 15 units

Take 4 thousands + 8 hundreds + 9 tens + 6 units

We can now take the 6 units from the 15 units but cannot take 9 tens from 2 tens until we take a *hundred* from the 7 hundreds and add it to the 2 tens, thereby making 12 tens, but leaving only 6 hundreds. So far our question will read :

From 8 thousands + 6 hundreds + 12 tens + 15 units

Take 4 thousands + 8 hundreds + 9 tens + 6 units

Nine tens may now be taken from 12 tens, but 8 hundreds cannot be taken from 6 hundreds until we take a *thousand* from the 8 thousands and changing it to hundreds, add to the 6 hundreds, thereby making 16 hundreds, and making the question finally read :

From 7 thousands + 16 hundreds + 12 tens + 15 units
 Take 4 thousands + 8 hundreds + 9 tens + 6 units

Our minuend is the same number as we began with, that is to say — 7 thousands, 16 hundreds, 12 tens, and 15 units is 8 thousands, 7 hundreds, 3 tens, and 5 units. We have rearranged it simply, in order to help in our subtraction. Six units from 15 units leave 9 units; 9 tens from 12 tens leave 3 tens; 8 hundreds from 16 hundreds leave 8 hundreds, and 4 thousands from 7 thousands leave 3 thousands, a difference of 4 thousands, 8 hundreds, 3 tens, and 9 units or 4839.

This is the common method of solving subtraction questions. It seems a little long, but practice will help the student to make all the changes mentally and thus gain time. After solving a dozen or more questions by actually rearranging the minuend, the students will be able to say as in the following example :

From 421
 Take 246

Six from eleven is five. Four from eleven is seven, and two from three is one — difference 175.

Exercise 24

1. How ought 77 to be written so that 38 may be subtracted?
2. How ought 63 to be written so that 29 may be taken away?
3. From 85 take 26, and from 43 take 27.
4. In question 3, what two numbers are equal to the third? How can you prove the correctness of the difference?
5. Arrange the following so that 29 may be easily taken - 41, 52, 63, 86, 94, and 137.

6. A farmer grew 81 bushels of potatoes. He kept 18 bushels for his own use and sold the remainder. How many bushels did he sell?

7. Mr. Thomas sold 75 dollars' worth of hay to his grocer who gave him in payment 29 dollars' worth of flour and the rest in cash. How much money was given Mr. Thomas?

8. Brown set out to walk from Winnipeg to Portage la Prairie, a distance of 56 miles. This he completed in two days. If he walked 26 miles the first day, how far did he walk on the second day?

9. A man owing a debt of 93 dollars, paid 19 dollars at one time, and 18 dollars at another. How much does he still owe?

10. Harry bought a rake for 35 cents, a spade for 23 cents, and a hoe for a quarter. He gave a dollar bill in payment. How much change did he get?

Exercise 25

NOTE.—Teacher and pupils should work together until the mechanical part of the process is learned.

Subtract and prove your remainders:

1.	$\begin{array}{r} 179 \\ 46 \\ \hline \end{array}$	$\begin{array}{r} 189 \\ 18 \\ \hline \end{array}$	$\begin{array}{r} 524 \\ 336 \\ \hline \end{array}$	$\begin{array}{r} 520 \\ 132 \\ \hline \end{array}$	$\begin{array}{r} 240 \\ 151 \\ \hline \end{array}$	$\begin{array}{r} 850 \\ 432 \\ \hline \end{array}$	$\begin{array}{r} 516 \\ 273 \\ \hline \end{array}$
2.	$\begin{array}{r} 476 \\ 287 \\ \hline \end{array}$	$\begin{array}{r} 653 \\ 469 \\ \hline \end{array}$	$\begin{array}{r} 706 \\ 537 \\ \hline \end{array}$	$\begin{array}{r} 965 \\ 386 \\ \hline \end{array}$	$\begin{array}{r} 630 \\ 398 \\ \hline \end{array}$	$\begin{array}{r} 326 \\ 179 \\ \hline \end{array}$	$\begin{array}{r} 579 \\ 384 \\ \hline \end{array}$
3.	$\begin{array}{r} 937 \\ 769 \\ \hline \end{array}$	$\begin{array}{r} 898 \\ 669 \\ \hline \end{array}$	$\begin{array}{r} 456 \\ 265 \\ \hline \end{array}$	$\begin{array}{r} 589 \\ 194 \\ \hline \end{array}$	$\begin{array}{r} 276 \\ 189 \\ \hline \end{array}$	$\begin{array}{r} 207 \\ 169 \\ \hline \end{array}$	$\begin{array}{r} 110 \\ 73 \\ \hline \end{array}$
4.	$\begin{array}{r} 643 \\ 478 \\ \hline \end{array}$	$\begin{array}{r} 737 \\ 369 \\ \hline \end{array}$	$\begin{array}{r} 895 \\ 756 \\ \hline \end{array}$	$\begin{array}{r} 800 \\ 634 \\ \hline \end{array}$	$\begin{array}{r} 985 \\ 686 \\ \hline \end{array}$	$\begin{array}{r} 876 \\ 598 \\ \hline \end{array}$	$\begin{array}{r} 707 \\ 596 \\ \hline \end{array}$

5.	<u>9385</u> <u>4256</u>	<u>8500</u> <u>7309</u>	<u>7000</u> <u>573</u>	<u>5600</u> <u>99</u>	<u>2100</u> <u>900</u>	<u>5685</u> <u>2496</u>
6.	<u>6582</u> <u>2135</u>	<u>5101</u> <u>3040</u>	<u>4021</u> <u>1223</u>	<u>8758</u> <u>5276</u>	<u>5444</u> <u>2445</u>	<u>7010</u> <u>2011</u>
7.	<u>972897</u> <u>120341</u>	<u>80502</u> <u>38672</u>	<u>705180</u> <u>443544</u>	<u>527082</u> <u>232456</u>		
8.	<u>423453</u> <u>141511</u>	<u>723250</u> <u>241341</u>	<u>834261</u> <u>659388</u>	<u>726014</u> <u>438907</u>		

9. From 70000 take 11, and from 100100110 take 990991.

Exercise 26

Subtract :

1.	<u>\$95.16</u> <u>76.18</u>	<u>\$87.25</u> <u>36.75</u>	<u>\$40.10</u> <u>29.15</u>	<u>\$70.05</u> <u>14.25</u>
2.	<u>\$130.20</u> <u>95.35</u>	<u>\$245.85</u> <u>176.07</u>	<u>\$238.32</u> <u>184.00</u>	<u>\$200.00</u> <u>99.75</u>
3.	<u>\$837.28</u> <u>469.30</u>	<u>\$777.50</u> <u>688.88</u>	<u>\$760.00</u> <u>489.00</u>	<u>\$505.65</u> <u>239.86</u>
4.	<u>\$1000.00</u> <u>899.95</u>	<u>\$1909.00</u> <u>1875.25</u>	<u>\$2001.25</u> <u>1870.07</u>	<u>\$4040.40</u> <u>3268.45</u>
5.	<u>\$6496.37</u> <u>5009.99</u>	<u>\$10000.00</u> <u>745.85</u>	<u>\$1111.11</u> <u>999.99</u>	<u>\$6648.30</u> <u>2799.28</u>
6.	<u>\$7248.50</u> <u>3675.25</u>	<u>\$4233.15</u> <u>3760.30</u>	<u>\$5021.87</u> <u>3929.19</u>	<u>\$6000.00</u> <u>29.17</u>

Find the difference between :

7. 7 yards 2 feet and 4 yards 1 foot; 8 yards 1 foot and 5 yards 2 feet.

8. 13 pounds 3 ounces and 12 pounds 5 ounces; 12 pounds 8 ounces and 9 pounds 12 ounces.

9. 16 quarts 2 pints and 9 quarts 3 pints; 5 gallons 3 quarts and 2 gallons 5 quarts.

10. 6 weeks 5 days and 3 weeks 6 days; 12 weeks 4 days and 8 weeks 5 days.

11. What number taken from the sum of 2471 and 156 will leave the difference between 3754 and 2683?

12. How often can 461 be taken from 5782?

13. A man receives \$1500 a year salary. Out of this he pays \$455 a year for board, \$345 a year for clothing, \$185 a year for books, and \$235 a year for other expenses. What can he save in 3 years?

14. Find the sum of the ages of 4 men who were born in 1830, 1839, 1843, and 1853 respectively.

Exercise 27

1. The following shows a merchant's receipts for several weeks. Find his total receipts for the time given in the table. Find also the difference between his receipts for the first and second weeks; the second and third weeks; the third and fourth weeks, and the fourth and fifth weeks:—

	MON.	TUES.	WED.	THURS.	FRI.	SAT.	TOTAL
1st	\$2564.15	\$1565.73	\$4830.65	\$1026.81	\$1899.73	\$1675.00	
2d	584.32	1082.36	873.15	860.43	764.28	1742.15	
3d	2542.76	798.30	1206.72	3210.95	1568.70	1672.19	
4th	3782.00	3672.45	923.84	972.67	1097.35	638.25	
5th	1345.75	834.70	2437.96	2056.80	587.76	1253.08	

2. A farmer bought 30 cows for \$540. He fed them for one year at a cash expense of \$245.75, and then sold the entire herd for \$870. How much did he gain or lose?

3. Bought a house for \$3127; built an addition costing \$730, and sold out for \$2898. How much was gained or lost?

4. Find the number which, subtracted from 800,000, leaves 751,936.

5. If you have no change except a 25-cent piece, a half-dollar piece, and a \$10 bill, how can you pay a bill of \$6.65 if your creditor has only two 10-cent pieces and a number of 2-dollar bills?

6. A and B had each \$24,950. A loaned B \$8060 and then borrowed of him \$16,845 and lost so much in speculating that B had \$6200 more than A. How much did A lose?

7. Take 395 from each of the following numbers: 563, 2768, 1024, 576, 10,021, 4200, 493, and 1000. Add the remainders.

8. To what number must 893 be added 4 times to make 3804?

9. The distance by rail from Winnipeg

To Brandon is 133 miles west.

To Virden is 180 miles west.

To Regina is 357 miles west.

To Calgary is 840 miles west.

To Vancouver is 1482 miles west.

To Toronto is 1193 miles east.

To Montreal is 1424 miles east.

By the aid of this table find the distance of Brandon from each place mentioned after it.

Exercise 28

1. A purchased a farm for \$10,750 and paid thereon \$5790. How much still remains to be paid? If \$1750 in improvements was spent on the farm, how much was gained if A sold for \$15,000?

2. A merchant bought goods which he sold for \$12,275 and cleared \$2118.75. Find the cost price of the goods.

3. The sum of two numbers is 9427. The greater number is 5825. Find the lesser number.

4. A certain town had a population of 25,967, which was 6878 more than that of the preceding year. What was the population the preceding year?

5. A farmer sold 6665 bushels out of a total yield of 15,400 bushels. How much has he still on hand?

6. If two candidates for office received a total vote of 53,462 and the successful candidate had 35,309 votes, how many people voted for the other?

7. From the sum of \$4750, \$2284, \$960, and \$435 take \$5863.

8. A man deposited \$175, \$141, \$75, \$304, and \$760.85 in a bank, and then drew out \$475 and \$235.90. How much remained in the bank to his credit?

9. A had \$17,650, B had \$1365 more than A, and C had \$985 less than both A and B together. How much had C? How much had A, B, and C together?

10. Perform the operations indicated in:

(a) $439 - 64 - 81 - 43$.

(b) $8910 - 702 + 264 - 361 - 1421$.

(c) $74891 - (4683 + 4267)$.

(d) $66674 + 843 - (9645 - 3726)$.

MULTIPLICATION

If we wished to find the total weight of 8 bags of shot each weighing 278 pounds, we might proceed as follows:

$$\begin{aligned}
 &278 \text{ is } 2 \text{ hundreds} + 7 \text{ tens} + 8 \text{ units} \\
 &8 \text{ times } 278 = 8 \text{ times } 2 \text{ hundreds} + 8 \text{ times } 7 \text{ tens} + 8 \\
 &\quad \text{times } 8 \text{ units} \\
 &= 16 \text{ hundreds} + 56 \text{ tens} + 64 \text{ units} \\
 &= 1600 + 560 + 64 \\
 &= 2224
 \end{aligned}$$

Eight bags of shot, then, will contain 2224 pounds.
We may save time by arranging our work thus:

$$\begin{array}{r}
 278 \\
 \quad 8 \\
 \hline
 64 \\
 560 \\
 1600 \\
 \hline
 2224
 \end{array}$$

In the foregoing the 64 is 8 times 8 units, the 560 is 8 times 7 tens and the 1600 is 8 times 2 hundred. Added together these numbers give 2224, the weight of the shot.

Instead of writing the 64, the 560, and the 1600 separately we may add them together as we go on with our work, and say:

Eight times 8 are 64 ones or 6 tens and 4; we set down the 4 and carry forward the 6 to the tens. Eight times 7 tens are 56 tens and these with the 6 tens carried over make 62 tens or 6 hundreds and 2 tens; setting down the 2 tens and carrying forward the 6 hundreds, we say, eight times 2 hundreds are 16 hundreds and these with the 6 tens carried

over make 22 hundreds, which we set down to the left of the 2 tens and 4 units already found, thus:

$$\begin{array}{r} 278 \\ 8 \\ \hline 2224 \end{array}$$

When we have to perform an example in multiplication, it is often convenient to call the number which we are asked to multiply the *multiplicand*, the number by which we are to multiply the *multiplier*, and the result or answer the *product*. In the above example, 278 is the *multiplicand*, 8 the *multiplier*, and 2224 the *product*.

Exercise 29

Multiply :

1.	$\begin{array}{r} 426 \\ 2 \\ \hline \end{array}$	$\begin{array}{r} 575 \\ 2 \\ \hline \end{array}$	$\begin{array}{r} 897 \\ 2 \\ \hline \end{array}$	$\begin{array}{r} 658 \\ 2 \\ \hline \end{array}$	$\begin{array}{r} 729 \\ 2 \\ \hline \end{array}$	$\begin{array}{r} 864 \\ 2 \\ \hline \end{array}$	$\begin{array}{r} 500 \\ 2 \\ \hline \end{array}$
2.	$\begin{array}{r} 975 \\ 3 \\ \hline \end{array}$	$\begin{array}{r} 868 \\ 3 \\ \hline \end{array}$	$\begin{array}{r} 749 \\ 3 \\ \hline \end{array}$	$\begin{array}{r} 653 \\ 3 \\ \hline \end{array}$	$\begin{array}{r} 527 \\ 3 \\ \hline \end{array}$	$\begin{array}{r} 444 \\ 3 \\ \hline \end{array}$	$\begin{array}{r} 866 \\ 3 \\ \hline \end{array}$
3.	$\begin{array}{r} 931 \\ 4 \\ \hline \end{array}$	$\begin{array}{r} 842 \\ 4 \\ \hline \end{array}$	$\begin{array}{r} 753 \\ 4 \\ \hline \end{array}$	$\begin{array}{r} 664 \\ 4 \\ \hline \end{array}$	$\begin{array}{r} 575 \\ 4 \\ \hline \end{array}$	$\begin{array}{r} 486 \\ 4 \\ \hline \end{array}$	$\begin{array}{r} 399 \\ 4 \\ \hline \end{array}$
4.	$\begin{array}{r} 876 \\ 5 \\ \hline \end{array}$	$\begin{array}{r} 787 \\ 5 \\ \hline \end{array}$	$\begin{array}{r} 698 \\ 5 \\ \hline \end{array}$	$\begin{array}{r} 509 \\ 5 \\ \hline \end{array}$	$\begin{array}{r} 410 \\ 5 \\ \hline \end{array}$	$\begin{array}{r} 321 \\ 5 \\ \hline \end{array}$	$\begin{array}{r} 232 \\ 5 \\ \hline \end{array}$
5.	$\begin{array}{r} 538 \\ 6 \\ \hline \end{array}$	$\begin{array}{r} 649 \\ 6 \\ \hline \end{array}$	$\begin{array}{r} 750 \\ 6 \\ \hline \end{array}$	$\begin{array}{r} 861 \\ 6 \\ \hline \end{array}$	$\begin{array}{r} 972 \\ 6 \\ \hline \end{array}$	$\begin{array}{r} 483 \\ 6 \\ \hline \end{array}$	$\begin{array}{r} 394 \\ 6 \\ \hline \end{array}$
6.	$\begin{array}{r} 823 \\ 7 \\ \hline \end{array}$	$\begin{array}{r} 934 \\ 7 \\ \hline \end{array}$	$\begin{array}{r} 745 \\ 7 \\ \hline \end{array}$	$\begin{array}{r} 656 \\ 7 \\ \hline \end{array}$	$\begin{array}{r} 567 \\ 7 \\ \hline \end{array}$	$\begin{array}{r} 478 \\ 7 \\ \hline \end{array}$	$\begin{array}{r} 389 \\ 7 \\ \hline \end{array}$
7.	$\begin{array}{r} 989 \\ 8 \\ \hline \end{array}$	$\begin{array}{r} 898 \\ 8 \\ \hline \end{array}$	$\begin{array}{r} 07 \\ 8 \\ \hline \end{array}$	$\begin{array}{r} 616 \\ 8 \\ \hline \end{array}$	$\begin{array}{r} 525 \\ 8 \\ \hline \end{array}$	$\begin{array}{r} 434 \\ 8 \\ \hline \end{array}$	$\begin{array}{r} 343 \\ 8 \\ \hline \end{array}$

8.	999	888	777	666	555	404	400
	9	9	8	9	9	9	9
9.	7468	8397	6579	7349	8756		
	8	9	7	6	5		
10.	93495	70168	83009	20009	55555		
	5	7	9	8	5		

Exercise 30

1. If it costs \$3479 to build one mile of a road, find how much 8 miles would cost.
2. Nine men put the same amount of money in a farm. Find the cost of the farm if each had to pay \$378.
3. In one mile there are 5280 feet. Find how many feet in 5 miles.
4. If 9 men can sow a farm in 25 days, in how many days can one man do the same?
5. If \$720 can keep a family in provisions for 18 months, what will be required to keep the same family 72 months?
6. At an auction sale there were sold 8 horses at \$175 each, 9 cows at \$37 each, 7 sheep at \$6 each, and 8 pigs at \$9 each. Find the amount received for all.
7. A father divided his estate among his four sons, giving each \$3545. What was the estate valued at?
8. Two men bought farms at \$85 an acre. The first bought a farm of 80 acres, the second a farm of 73 acres. How much more had one to pay than the other?
9. Find the cost of:
 - 4 pounds of tea at 35 cents a pound,
 - 9 pounds of rice at 6 cents a pound,
 - 8 pounds of coffee at 40 cents a pound, and
 - 1 bottle of pickles at 35 cents.

10. There are 4 shelves in a bookcase, each containing 18 books; 6 shelves, each containing 27 books; and 5 shelves each containing 19 books. How many books are in the bookcase?

11. Two schoolhouses were to be furnished with single desks. One had eight rooms, each large enough for 49 desks, the other had 9 rooms, each large enough for 56 desks. How many desks would have to be purchased?

12. From the sum of 8723, 57, 381, 9568, 7, and 239 take the difference between 8165 and 14968 and multiply the result by 9.

Exercise 31

1. Write 726 ten times and add. How many times 726 are there in this sum? How do the figures in the sum differ from the figures in 726?

2. Write 1839 ten times and add. How many times 1839 is the sum? How do the figures in 18390 differ from those in 1839?

3. Multiply 7, 6, 5, 9, 8, and 12 by 10. Give a simple rule for multiplying a number by 10.

4. Multiply 73, 46, 189, 80, and 800 each by 10.

5. Multiply 4397, 6000, 72836, and 90109 each by 10.

6. How can you get 20 times a number from 10 times the number? How can you get 30 times a number from 10 times the number? How can you get 80 times the number from 10 times the number?

7. Multiply :

38 by 20	46 by 30	75 by 40	86 by 60
76 by 20	75 by 30	68 by 40	48 by 60
184 by 20	273 by 30	272 by 40	342 by 60
358 by 20	849 by 30	397 by 40	789 by 60

8. Multiply :

485 by 80	596 by 90	673 by 40	427 by 50
7273 by 80	8489 by 90	8777 by 40	7788 by 50
9346 by 80	4368 by 90	9988 by 40	9449 by 50

9. $758 \times 80 =$ how many tens?

$673 \times 70 =$ how many tens?

$449 \times 90 =$ how many tens?

$634 \times 20 =$ how many tens?

$777 \times 50 =$ how many tens?

$937 \times 40 =$ how many tens?

$665 \times 30 =$ how many tens?

$548 \times 60 =$ how many tens?

10. 73×5 tens = how many tens?

96×8 tens = how many tens?

48×9 tens = how many tens?

79×7 tens = how many tens?

73×5 ones = how many ones?

96×8 ones = how many ones?

48×9 ones = how many ones?

79×7 ones = how many ones?

Compare the numbers representing the number of *tens*, and the number of *ones*. In what do the two agree? In what do they differ? Which is the more difficult, to multiply a number by tens and give the answer in tens, or to multiply the same number by ones and give the answer in ones?

NOTE. — 73×5 is a shortened form for 73 multiplied by 5, which is read five *times* seventy-three. This is the meaning given the sign \times in this series.

Exercise 32

Before working the following exercise it will be necessary to become acquainted with the special form of working mul-

multiplication questions. Taking the example 78×96 we set down multiplicand and multiplier thus :

$$\begin{array}{r} 78 \\ 96 \\ \hline \end{array}$$

Here we have to find two products the sum of which is the product we are to obtain. These products result from multiplying 78 by 6 ones and from multiplying 78 by 9 tens.

Multiplying 78 by 6 ones we get 468 ones which we set down as shown below. Multiplying 78 by 9 tens we get 702 tens. Observing that units must be placed under units and tens under tens, we place the above products as follows :

$$\begin{array}{r} 78 \\ 96 \\ \hline 468 = 6 \text{ times } 78 \\ 702 = 90 \text{ times } 78 \\ \hline 7488 = 96 \text{ times } 78 \end{array}$$

Find the product of :

- | | | |
|----|----------------|----------------|
| 1. | 34×26 | 87×82 |
| | 48×39 | 55×35 |
| | 73×64 | 77×38 |
| | 50×31 | 69×73 |

Multiply :

2.	$\begin{array}{r} 468 \\ 54 \\ \hline \end{array}$	$\begin{array}{r} 729 \\ 63 \\ \hline \end{array}$	$\begin{array}{r} 836 \\ 89 \\ \hline \end{array}$	$\begin{array}{r} 727 \\ 45 \\ \hline \end{array}$	$\begin{array}{r} 525 \\ 36 \\ \hline \end{array}$
3.	$\begin{array}{r} 238 \\ 57 \\ \hline \end{array}$	$\begin{array}{r} 189 \\ 38 \\ \hline \end{array}$	$\begin{array}{r} 300 \\ 74 \\ \hline \end{array}$	$\begin{array}{r} 950 \\ 61 \\ \hline \end{array}$	$\begin{array}{r} 676 \\ 90 \\ \hline \end{array}$
4.	$\begin{array}{r} 4624 \\ 35 \\ \hline \end{array}$	$\begin{array}{r} 3846 \\ 39 \\ \hline \end{array}$	$\begin{array}{r} 4862 \\ 57 \\ \hline \end{array}$	$\begin{array}{r} 9846 \\ 73 \\ \hline \end{array}$	$\begin{array}{r} 8701 \\ 68 \\ \hline \end{array}$
5.	$\begin{array}{r} 54316 \\ 82 \\ \hline \end{array}$	$\begin{array}{r} 65427 \\ 73 \\ \hline \end{array}$	$\begin{array}{r} 86538 \\ 84 \\ \hline \end{array}$	$\begin{array}{r} 97649 \\ 95 \\ \hline \end{array}$	$\begin{array}{r} 18750 \\ 37 \\ \hline \end{array}$

6. Multiply each number in the following columns by 58, 89, 47, 63, and 74:

245	483	1898	42471
709	759	6966	47973
698	498	3054	12820
737	665	2505	55040

Multiply:

7. 4387	7968	4205	8371	9967
55	77	99	44	66
8. 4975	7846	9327	6681	9948
63	84	93	62	42

Exercise 33

1. A man's salary is one thousand dollars a year, and his expenses \$75 a month. How much can he save in one year? in 7 years? in 25 years?

2. A workman who can earn \$4 a day, works 24 days per month. Find his yearly earnings. If his expenses are \$15 per week, what can he save in 18 months?

3. Find the value of:

- 37 sheep at \$9 each,
- 26 cows at \$37 each,
- 98 horses at \$138 each,
- 33 pigs at \$16 each, and
- 8 dozen ducks at \$8.45 a dozen.

4. A man bought:

- 84 barrels of flour at \$6.35 a barrel,
- 13 barrels of apples at \$3.50 a barrel,
- 75 pounds of cheese at 15 cents a pound,
- 58 bags of flour at \$2.75 a bag, and
- 96 pounds of butter at 28 cents a pound.

Find the total cost of his purchases.

5. In a field of potatoes there are 75 rows, each row having 96 hills, and each hill 15 potatoes. How many potatoes are there in the field?

6. A merchant bought 18 tubs of butter, each weighing 37 pounds, at 23 cents a pound. What did it cost?

7. If a garrison of soldiers consume 4865 pounds of bread a day, how much bread will supply the garrison during the month of March?

8. If a man-of-war can steam 18 miles in one hour, how far can it steam in 16 days of 24 hours each?

9. How many letters are there in a book of 56 pages, each page containing 24 lines, and each line 26 letters?

10. It takes 2346 boards to fence one side of a square garden. How many boards will be required to fence a garden of the same shape but four times as large?

11. A merchant tailor bought 84 overcoats at \$16.85 each; he sold half of them at \$24 each, and the others he sold for \$760. How much did he gain or lose?

12. If 73468 persons travel each day on the Grand Trunk Railway, find how many are travelling by this road during the month of August.

13. Find the value of 64 pails of berries, each pail holding $2\frac{1}{2}$ gallons, at 12 cents a quart.

14. Harry had a refreshment stand at which he sold peanuts, popcorn, candy, and lemonade. His expenses were.

1 bushel of peanuts at \$1.25 a bushel.

Roasting the peanuts, 29 cents.

8 pounds of candy at 35 cents a pound.

1 package of popcorn at 40 cents.

1 cake of maple sugar, 25 cents.

3 dozen lemons at 30 cents a dozen.

6 pounds of sugar at 6 cents a pound.

(a) How much did he pay for each article?

(b) What did he pay for all?

15. From the popcorn and maple sugar he made 50 popcorn balls. From the lemons and the sugar he made 75 glasses of lemonade. He sold the peanuts at 8 ct. a pint, the candy at 15 ct. a $\frac{1}{2}$ -pound box, the popcorn at 2 balls for 7 ct., and the lemonade at 5 cts. a glass.

(a) How much did he get from the sale of the peanuts?

(b) How much did he get from the sale of the lemonade?

(c) How much did he get from the sale of the popcorn?

(d) How much did he get from the sale of the candy?

(e) How much did he get all together?

(f) How much did he make?

Exercise 34

1. Multiply 9860 by 10. How many times 986 is 98600? How do the figures of 98600 differ from those of 986?

2. Multiply 4450 by 10. How many times 445 is this product? Make a simple rule for multiplying a number by 100.

3. Multiply 3562, 8921, 4376, 284, 93, and 8 by 10.

4. Multiply 9, 54, 275, 632, 807, 100, and 3572 by 100.

5. Multiply 15, 4, 387, 269, 4287 by 1000.

6. Multiply 6, 16, 326, 589, and 73460 by 10000.

7. How can you get 200 times a number from 100 times the number? How can you get 700 times a number from 100 times the number? How get 900 times a number from 100 times the number?

8. Multiply :

46 by 200	37 by 300	97 by 800
57 by 200	29 by 300	89 by 800
97 by 200	84 by 300	78 by 800
269 by 200	365 by 300	66 by 800
748 by 200	720 by 300	35 by 800

9. $76 \times 200 =$ how many hundreds?
 $93 \times 300 =$ how many hundreds?
 $84 \times 400 =$ how many hundreds?
 $136 \times 500 =$ how many hundreds?
 $725 \times 600 =$ how many hundreds?
 $636 \times 700 =$ how many hundreds?
 $999 \times 800 =$ how many hundreds?
 $483 \times 900 =$ how many hundreds?

10. 195×2 hundreds = how many hundreds?
 276×3 hundreds = how many hundreds?
 384×4 hundreds = how many hundreds?
 565×5 hundreds = how many hundreds?
 431×6 hundreds = how many hundreds?
 662×7 hundreds = how many hundreds?
 788×8 hundreds = how many hundreds?
 807×9 hundreds = how many hundreds?

11. 88×9 hundreds = how many hundreds?
 66×8 hundreds = how many hundreds?
 45×7 hundreds = how many hundreds?
 73×6 hundreds = how many hundreds?
 88×9 tens = how many tens?
 66×8 tens = how many tens?
 45×7 tens = how many tens?
 73×6 tens = how many tens?

Compare in the foregoing the numbers representing the number of *hundreds* and the number of *tens*. In what respect do these numbers agree? In what do they differ?

12. $89 \times 2000 =$ how many thousands?
 $48 \times 3000 =$ how many thousands?
 $66 \times 4000 =$ how many thousands?
 $73 \times 5000 =$ how many thousands?

Exercise 35

1. Multiply 354 by 243.

We have to multiply 354 by 2 hundreds, 4 tens, and 3 ones, or better, by 3 ones, 4 tens, and 2 hundreds. 3 times 3 hundreds 5 tens and 4 ones gives 1062 ones. 4 tens times the same gives 1416 tens, and 2 hundreds times the same gives 708 hundreds, all of which are set down as follows:

$$\begin{array}{r}
 354 \\
 243 \\
 \hline
 1062 = 3 \text{ times } 354 \\
 1416 = 40 \text{ times } 354 \\
 708 = 200 \text{ times } 354 \\
 86022 = 243 \text{ times } 354
 \end{array}$$

Multiply :

2.	<u>313</u>	<u>342</u>	<u>809</u>	<u>456</u>	<u>517</u>	<u>907</u>
	<u>232</u>	<u>114</u>	<u>245</u>	<u>324</u>	<u>246</u>	<u>617</u>
3.	<u>843</u>	<u>749</u>	<u>675</u>	<u>861</u>	<u>972</u>	<u>444</u>
	<u>108</u>	<u>281</u>	<u>376</u>	<u>510</u>	<u>400</u>	<u>999</u>
4.	<u>4081</u>	<u>7012</u>	<u>1000</u>	<u>3978</u>	<u>3684</u>	<u>9675</u>
	<u>288</u>	<u>550</u>	<u>223</u>	<u>729</u>	<u>666</u>	<u>835</u>
5.	<u>3728</u>	<u>4936</u>	<u>5093</u>	<u>4725</u>	<u>5769</u>	<u>9347</u>
	<u>287</u>	<u>356</u>	<u>186</u>	<u>328</u>	<u>318</u>	<u>500</u>
6.	<u>57423</u>	<u>38765</u>	<u>74158</u>	<u>85269</u>	<u>96370</u>	
	<u>519</u>	<u>620</u>	<u>731</u>	<u>842</u>	<u>953</u>	

7.	<u>3207</u> <u>2345</u>	<u>6579</u> <u>3506</u>	<u>8569</u> <u>4006</u>	<u>3648</u> <u>4273</u>	<u>8463</u> <u>3652</u>
8.	<u>3794</u> <u>2389</u>	<u>7403</u> <u>3584</u>	<u>8165</u> <u>7090</u>	<u>2146</u> <u>5566</u>	<u>9349</u> <u>1001</u>

9. Find the following products :

648×10	2572×94
765×100	4372×603
833×10000	7689×16000
1011×574	4004×999

10. The multiplier is 936, the multiplicand six thousand four hundred and seventy-five: find the product.

11. Compare the products of:

273×348 and 348×273
461×769 and 769×461
385×667 and 667×385

12. How do you prove the correctness of your work in multiplication? If you cannot answer this at once, examine again the two columns of products in question 11.

13. Find the following products and prove their correctness:

685×246	967×365	838×531
723×834	574×637	459×942

14. Which number, the larger or the smaller, should you select for a multiplicand in order to get the product with the least labor? Find the product in each of the following cases by observing this arrangement:

29×384	3142×35	27×564
497×36	70×11238	325×45

Exercise 36 (Review)

1. Find the cost of each of the following items and add the results together:

57 bushels of turnips at \$0.39 per bushel.
425 pounds of butter at \$0.23 per pound.
324 pounds of coffee at \$0.35 per pound.
26 boxes of soap at \$4.75 per box.
18 pitchers at \$0.60 each.
15 dozen lamp chimneys at \$0.95 per dozen.
720 pounds of rice at 9 cents per pound.

2. A merchant bought the following goods:

72 yards nun's veiling at 80 cents per yard.
6 dozen pairs hose at 35 cents per pair.
96 yards sateen at 47 cents per yard.
20 dozen towels at 30 cents per pair.
300 spools sewing silk at 7 cents per spool.
875 yards factory cotton at 9 cents per yard.

How much had the merchant to pay?

3. A farmer ploughed 120 acres at a cost of \$1.65 per acre. He sowed it with wheat at a cost of \$1.35 per acre. He harvested the farm at a cost of \$2 per acre, and threshed it at a cost of 85 cents per acre. He sold the wheat at 83 cents per bushel. How much did he clear, the *average yield* being 24 bushels per acre? What does *average yield* mean?

4. Find the value of 20 dozen baskets of berries at \$2.35 per basket. If the contents of 8 baskets were spoiled, what will be gained by selling the remainder at \$3.20 per basket?

5. A farmer sold a merchant 96 bushels of potatoes at 58 cents per bushel, 175 pounds of butter at 28 cents per pound, and 186 dozen eggs at 35 cents per dozen. In exchange the

merchant sold the farmer 13 pounds of tea at 45 cents per pound, 2 barrels of apples at \$3.75 per barrel, a box of raisins at \$4.35, and 23 yards of tweed at 67 cents per yard. Which person owes and how much?

6. A grain buyer bought 1684 bushels of wheat for \$1128.28 and sold it at 87 cents per bushel. What was the gain?

7. A factory employs 81 men at \$1.85 a day, and 35 men at \$2.76 a day. The other expenses are \$217.35 a day. How much does it cost to keep the factory going a month of 23 days?

8. How much will it cost to build a telegraph line from Portage la Prairie to Brandon, a distance of 77 miles, at \$1275 per mile?

9. I bought 563 cheeses weighing with the cases 39 pounds each. Each case weighs 4 pounds. What did the cheese cost at 13 cents per pound?

10. A man sold 87 horses at 135 dollars each and received in payment 43 cows at 37 dollars each, 75 sheep at 12 dollars each, \$7004 in cash, and a note for the balance. What was the value of the note?

11. A miller manufactured 560 barrels of flour, and sold it at \$9 per barrel; the wheat cost him \$2750, and the expense of running the mill \$960. How much did he make?

12. A cattleman bought 389 head of cattle in Alberta at \$45 a head, shipped them to Winnipeg at an expense of \$6 a head, and then sold them at \$57 a head. How much did he make?

13. A man bought a half-section of land for \$9100. He sold 60 acres of it at \$58 an acre, and the remainder at \$37 an acre. How much did he make?

14. A real estate dealer bought 500 acres of land at \$30 an acre. He sold 75 acres at \$40 an acre and 180 acres at \$54 an acre. How much did he receive for the two lots sold? How many acres has he left? If he should sell what he has left for the price that it cost him, how much would he gain on the whole? If he had sold all the land at \$42 an acre, how much would he have gained?

15. A grocer bought 200 barrels of flour at \$5 a barrel. He sold 97 barrels at \$5.50 a barrel, 53 barrels at \$6 a barrel, and sold the remainder at cost. How much did he gain? How much would he have gained had he sold the remainder at \$7.50 a barrel?

16. A farmer who raised 3456 bushels of oats kept 105 bushels for seed and enough to winter 15 horses and 18 cows. He sold the remainder. If the horses were allowed 42 bushels each and the cows 12 bushels each, how many bushels were sold?

17. A man rented a skating-rink for 6 weeks at \$85 per week. His expenses for heat and light were \$1.85 per day. He charged 60 cents for adults and 35 cents for children. The total attendance of the former was 3768, and of the latter, 2456. How much did he gain or lose?

18. A laborer receives \$26 a month and board for 9 months of the year; the rest of the year he is idle and pays \$16 a month for board. Allowing him \$45 a year for other expenses, how much should he save in 4 years?

Exercise 37

1. If you multiply a number by 7 and then multiply the result by 8, how many times the number have you? Test this by taking any example.

2. If you multiply a number by 9 and the result by 7, how many times the number have you?

3. Multiplying any number by 5 and the result by 6 is multiplying the number by what?

4. Eight times 8 times any number is how many times that number? Seven times 9 times a number is how many times the number?

5. What numbers multiplied together give the following: 63, 35, 81, 27, 18, 24, 96, and 72? These numbers are called the *factors* or makers of 63, 35, 81, etc.

6. Name two factors of 45, 10, 32, 42, and 60, and three factors of 24, 60, 42, and 36.

7. Using the factors of the multipliers, find the following products:

723 × 12	198 × 35	4286 × 42	9478 × 44
387 × 81	560 × 84	7309 × 50	6439 × 72
475 × 54	373 × 28	9767 × 18	8800 × 96
928 × 25	659 × 30	3456 × 16	3397 × 15
653 × 48	777 × 36	7229 × 40	7017 × 21

8. Work, first by the ordinary method and second by using factors:

$$\begin{aligned} &3675 \times 35 \\ &3486 \times 42 \\ &4628 \times 48 \\ &6696 \times 18 \end{aligned}$$

Compare the results. When should the method of factors be used in multiplication?

Exercise 38

1. During the months of November and December Clara attended school 34 days. How many days did she stay at home?

2. A man bought 7 bushels of potatoes at 65 cents a bushel and sold them at the rate of 20 cents a peck. Find the cost, the selling price, and the gain.

3. If I should buy a piece of cloth containing 54 yards at 10 cents a yard, and should sell $\frac{1}{3}$ of it at 12 cents a yard, and the remainder at 9 cents a yard, how much should I gain?
4. A man bought two lots for \$1000 each. He sold one of them for \$850 and the other for \$1325. How much did he gain?
5. A man bought 30 boxes of berries at 8 cents a box. He sold $\frac{2}{5}$ of them at 10 cents a box, $\frac{1}{3}$ of them at 12 cents, and the remainder at 9 cents a box. Find his gain.
6. I bought $3\frac{1}{2}$ dozen eggs at 14 cents a dozen and sold them at 20 cents a dozen. What was my profit?
7. I bought at a hardware store, 12 pounds of paint at 8¢ a pound, 100 pounds of nails at 4¢ a pound, a hammer for 35¢, and 2 brushes at 30¢ each. What had I to pay?
8. Find the amounts of these bills:
- (a) 3 pounds of beef at 17¢.
2 pounds of coffee at 35¢.
3 pounds of cheese at 15¢.
2 dozen eggs at 23¢.
 - (b) 7 yards of flannel at 25¢.
11 yards of ribbon at 21¢.
7 pairs of hose at 30¢.
6 skeins of yarn at 19¢.
9. If 3 barrels of flour cost \$13.50, how much will 12 barrels of flour cost?
10. If a man earns \$26.25 a week and spends \$18.25 a week, how much will he save in 12 weeks?
11. A man set out at 8 A.M. to row down a river at the rate of 6 miles an hour. How far had he rowed at 12.15 P.M.? What time was it when he had rowed 27 miles?
12. A man deposited in the bank \$50.65, \$743.85, \$268.50, and \$84.35. He drew out \$145, \$43.70, and \$56.85. How much remained in the bank?

13. (a) $100 + 150 + 250 + 300 = ?$
 (b) $350 - 150 + 400 + 225 = ?$
 (c) $225 + 200 + 175 - 100 = ?$
 (d) $1000 + 2500 + 3000 - 1500 = ?$
 (e) $10000 - 500 + 3500 - 1500 = ?$

14. If I should buy a horse for \$96 and should sell him so as to gain $\frac{1}{6}$ as much as he cost, how much would I gain? What would my selling price be?

15. A man earned \$30 one week and \$24 the next week. He paid \$4.50 each week for board, and bought a suit of clothes for \$16.50. How much money had he left?

16. A man earned \$16 a week for two weeks, and then did nothing for three weeks. He paid \$4.75 a week for his board the whole time. How much money had he left?

17. Read these numbers:

10465	1500600	600000000
19090	5280640	80340910
305630	10000000	756893249
1010101	12012012	5400897601

18. How much will a quire of paper cost at one-half cent a sheet?

19. What would it cost to send a message of 17 words at the rate of 50¢ for 10 words and 4¢ for each additional word?

20. Add:

(a)	(b)	(c)	(d)	(e)	(f)	(g)
24	25	63	20	11	25	35
36	26	64	30	12	25	46
42	27	21	40	13	25	57
32	25	83	50	14	25	93
75	26	90	60	15	50	39
18	27	77	70	16	50	28
24	40	34	80	17	50	64
25	30	96	90	18	50	31

21. Subtract:

(a)	(b)	(c)	(d)
\$432.75	\$467.35	\$600.16	\$1095.40
<u>159.69</u>	<u>389.27</u>	<u>549.54</u>	<u>346.75</u>
\$272.06	\$77.08	\$50.62	\$748.65
\$756.20	\$900.00	\$328.19	\$5600.50
<u>639.73</u>	<u>777.77</u>	<u>267.37</u>	<u>1320.25</u>
\$116.47	\$122.23	\$260.82	\$4380.25

22. Find the cost of each of the following:

(a)	(b)
35 barrels flour at \$6.50	38 yards cotton at 6¢
46 bags flour at \$2.85	52 yards flannel at 35¢
29 bags bran at 87¢	73 yards cashmere at 65¢
256 pounds oatmeal at 6¢	47 yards muslin at 23¢
34 pounds cornmeal at 11¢	75 yards lace at \$1.05
(c)	(d)
37 pounds pork at 18¢	14 cords poplar at \$4.75
42 pounds beef at 17¢	13 cords ash at \$5.00
16 pounds mutton at 15¢	23 cords tamarack at \$5.75
12 pounds veal at 20¢	17 cords Jackpine at \$5.25
8½ pounds turkey at 18¢	19 cords oak at \$7.28

DIVISION

If you were asked how many sevens there are in 83, how would you proceed to reach your answer?

Would you say:

83 is 77 and 6,

that is, 11 sevens and 6?

Or would you say:

83 is 70 and 13,

that is, 10 sevens + one seven and 6,

or 11 sevens and 6?

In formal division, when long *Dividends* (numbers to be divided) and often large *Divisors* (numbers by which we divide) are used, the latter method is the one employed. We shall now proceed to illustrate this method by taking several examples:

Ex. 1. Divide 84 by 4.

$$84 = 8 \text{ tens and } 4 \text{ ones.}$$

Therefore, $84 \div 4 = 2 \text{ tens and } 1$
 $= 21.$

Ex. 2. Divide 96 by 4.

$$96 = 9 \text{ tens and } 6 \text{ ones}$$

$$= 8 \text{ tens and } 16 \text{ ones.}$$

Therefore, $96 \div 4 = 2 \text{ tens and } 4 \text{ ones}$
 $= 24.$

In Ex. 2 we had to rearrange the tens, breaking the 9 tens into 8 tens and 1 ten.

Ex. 3. Divide 848 by 4.

$$848 = 8 \text{ hundreds} + 4 \text{ tens} + 8 \text{ ones.}$$

Therefore, $848 \div 4 = 2 \text{ hundreds} + 1 \text{ ten} + 2 \text{ ones}$
 $= 212.$

Ex. 4. Divide 9656 by 4.

$$9656 = 9 \text{ thousands} + 6 \text{ hundreds} + 5 \text{ tens} + 6 \text{ ones.}$$

Rearranged, $= 8 \text{ thousands} + 16 \text{ hundreds} + 4 \text{ tens} + 16 \text{ ones.}$

Therefore, $9656 \div 4 = 2 \text{ thousands} + 4 \text{ hundreds} + 1 \text{ ten} + 4 \text{ ones.}$
 $= 2414.$

Simplified, we set down the *Dividend*, *Divisor*, and *Quotient*, as follows:

$$\begin{array}{r} \text{Divisor } 4 \overline{) 9656} \text{ Dividend.} \\ 2414 \text{ Quotient.} \end{array}$$

This is all that appears in our exercise book ; the rearrangement and division being done mentally, thus :

Four will go into 9 thousand **2 thousand times**, leaving one thousand as a remainder to be added to the 6 hundreds. Setting down the 2 thousands in the thousands' place of our quotient, we next say, four into 16 hundreds will go just **4 hundred times**. Setting down the 4 in the hundreds' place of the quotient, we say, four into 5 tens goes **1 ten times** and leaves a remainder of ten, which is added to the 6 ones. Setting down the one ten in the tens' place of the quotient, we finally say, four into 16 ones goes just **4 times**, the 4 being placed in the units' place of the quotient, as above.

Were the dividend 9659 instead of 9656, we would have a remainder of 3. This we would set down by stating its ratio to the divisor, namely, $\frac{3}{4}$, and our whole quotient would read $2414\frac{3}{4}$, or two thousand four hundred fourteen and three-fourths.

Exercise 39

1. How many twos are there in 18, 24, 36, and 86 ? How many threes are there in 24, 27, 36, and 54 ? How many fours are there in 25, 37, 99, and 66 ? How many sixes are there in 73, 65, 98, and 49 ?

2. How many sevens are there in 15, 23, 31, 42, 57, and 62 ? How many eights are there in 19, 27, 35, 43, 51, and 64 ? How many nines are there in 17, 23, 31, 43, 57, and 91 ?

3. Divide :

824 by 2	963 by 3	324 by 4	725 by 5
762 by 2	693 by 3	464 by 4	800 by 5
684 by 2	396 by 3	820 by 4	965 by 5
466 by 2	606 by 3	936 by 4	725 by 5
848 by 2	666 by 3	884 by 4	835 by 5

4. Divide:

636 by 6	784 by 7	840 by 8	909 by 9
996 by 6	791 by 7	560 by 8	819 by 9
606 by 6	840 by 7	808 by 8	918 by 9
900 by 6	875 by 7	720 by 8	720 by 9
720 by 6	980 by 7	664 by 8	639 by 9

5. Divide:

235 by 3	749 by 8	567 by 8	724 by 9
457 by 4	835 by 9	385 by 6	800 by 7
368 by 5	453 by 8	745 by 7	600 by 8
279 by 6	493 by 2	853 by 4	700 by 3
463 by 7	743 by 3	492 by 5	200 by 6

6. Divide:

4321 by 3	7000 by 9	4654 by 9	5349 by 9
5678 by 4	4623 by 8	2727 by 8	4587 by 8
4566 by 5	8371 by 7	3636 by 7	2340 by 6
8321 by 6	9229 by 2	4005 by 3	9321 by 4

7. 76543 ÷ 2	50921 ÷ 8	48054 ÷ 9
43936 ÷ 3	44444 ÷ 9	63763 ÷ 4
72008 ÷ 5	55055 ÷ 6	40000 ÷ 7
63063 ÷ 4	96505 ÷ 7	92145 ÷ 8

8. 243990 ÷ 4	966472 ÷ 8	844800 ÷ 8
467034 ÷ 5	455463 ÷ 9	700000 ÷ 3
284573 ÷ 6	722632 ÷ 4	900909 ÷ 7
215607 ÷ 7	932133 ÷ 3	210012 ÷ 9

9. 26 ÷ 13	32 ÷ 16	38 ÷ 19	60 ÷ 12
51 ÷ 17	52 ÷ 14	54 ÷ 18	75 ÷ 15
64 ÷ 16	78 ÷ 13	66 ÷ 22	87 ÷ 29
76 ÷ 19	90 ÷ 15	68 ÷ 17	95 ÷ 19
88 ÷ 11	91 ÷ 13	70 ÷ 14	69 ÷ 23

10. $76 + 38$	$55 + 11$	$58 + 29$	$93 + 31$
$88 + 11$	$72 + 24$	$65 + 13$	$56 + 14$
$98 + 14$	$84 + 12$	$80 + 20$	$72 + 18$
$96 + 16$	$80 + 16$	$60 + 30$	$81 + 27$
$94 + 47$	$99 + 11$	$70 + 35$	$60 + 15$

NOTE. — Questions 9 and 10 are to be worked in class orally.

Exercise 40

1. If 3 books sell for 45 ct., what will 4 books sell for?
2. If 9 yards of calico sell for 63 ct., what is calico a yard?
3. If the profits in a business amounted to \$348, and were equally divided among 3 partners, how much would each man get?
4. How long will it take a man to pay a debt of \$564 if he pays \$8 a month?
5. How many weeks are there in 2000 days?
6. In 192 feet how many yards? In 219 feet how many yards?
7. In 3728 quarts how many gallons? In 1864 pecks how many bushels? In 1728 quarts how many pints?
8. In 1664 ounces how many half-pounds? In 800 ounces how many quarter-pounds? In 1000 pounds how many ounces?
9. If 8 acres of land cost \$728, what would 5 acres of the same land cost?
10. Mary wishes to buy a book for which the dealer asks \$2.70. If she gets 9 cents a quart for picking berries, how many quarts must she pick in order to earn enough to buy the book? If she can pick 5 quarts per day, how long will she take?

11. How many barrels of apples at \$5 a barrel can be bought for \$3565?

12. A mill worth \$79,940 was owned by 7 men, in equal shares. What was the value of a share?

13. A man left \$28,778 to be divided thus: to his widow, \$10,000, to his son, \$8000, to each of 4 brothers, \$200, and the rest to be equally divided among his 3 daughters. What will each daughter receive?

14. A farmer bought 3 horses and 4 mules for \$1122. The mules cost \$144 each. Find what he paid for each of the horses.

15. A man bought wheat at 47 ct. a bushel and sold it at 56 ct. a bushel. If his gain was \$2081.25, find how many bushels of wheat were sold.

16. If 12 men can build a fence in 33 days, in what time could 3 men build the same fence? in what time could 36 men build it?

17. \$8961.20 is 8 times as much as I paid for a house which cost me \$120 more than the house was worth. What was the house worth?

18. A man earns \$60 a month. His expenses are \$52 a month. In how many years can he save enough to purchase 48 acres of land at \$17 an acre?

19. I sold 56 horses at \$124 each, and then bought 240 sheep at \$12 each, 8 cows at \$64 each, and invested the rest in calves at \$8 each. How many calves did I buy?

20. If 5 sheep can be bought for \$20, how many tons of hay at \$8 a ton must be given in exchange for 472 sheep?

21. A and B are 3652 miles apart and approach each other, A travelling 15 miles an hour, and B 18 miles an hour. In how many hours will they meet?

22. I bought 54 head of cattle at \$35 a head, and paid cash \$1722, and the remainder in pigs at \$8 a head. How many pigs were required to settle the debt?

23. How many sevens must we add to get 819?

24. How often can we subtract 9 from 729?

25. A railway charges 2 cents a mile for the first 50 miles for carrying a cord of wood, and then 3 cents for every 4 additional miles. What will it cost at this rate to carry 72 cords 70 miles?

26. It is found that if 497 be subtracted 9 times from a certain number, the remainder is 200. Find the number from which the subtraction has been made.

27. A merchant mixes 2 pounds of tea worth 45 ct. per pound with 3 pounds worth 70 ct. What will 7 pounds of this mixture cost?

28. A farmer mixes 3 bushels of oats worth 28 ct. a bushel with 4 bushels of barley worth 36 ct. a bushel. What will 3 bushels of this mixture be worth?

29. What is gained or lost by selling 120 apples at a cent apiece, if half the number were bought at the rate of 5 for 6 ct., and the rest at 3 for 2 ct.?

30. Three omnibuses carry 23 persons, 32 persons, and 26 persons, respectively. If 2 persons leave one of the omnibuses and 11 more persons are taken up, how can the party be so divided that the omnibuses shall have equal numbers?

31. A farm has five fields: the first containing 178 acres, the second 202 acres, the third 348 acres, the fourth 184 acres, and the fifth 144 acres. If the farm be redivided into five fields of equal areas, how many acres will each contain?

32. A railway 360 miles long has a station every 6 miles, how many stations has it?

Exercise 41

1. Read as tens: 70, 80, 30, 200, 800, 1200, and 3000.
2. How many tens in 75, 87, 38, 250, 870, 925, 1231, and 3103?
3. What do you do in order to divide any number into tens?

4. Find the value of:

$74 \div 10$	$350 \div 10$	$7289 \div 10$
$93 \div 10$	$3500 \div 10$	$9600 \div 10$
$127 \div 10$	$4540 \div 10$	$8808 \div 10$
$468 \div 10$	$5645 \div 10$	$74563 \div 10$

5. If 10 cords of wood were sold for \$4870, find the selling price of one cord.

6. If 10 binders were purchased for \$1250.80, what did one binder cost?

7. Read as hundreds: 400, 500, 900, 1000, 1450, and 72840.

8. How many hundreds in 385, 768, 999, 1250, 1570, and 82040?

9. What do you do in order to divide any number into hundreds?

10. Find the value of:

$756 \div 100$	$1251 \div 100$	$8000 \div 100$
$864 \div 100$	$1548 \div 100$	$10000 \div 100$
$972 \div 100$	$2000 \div 100$	$16400 \div 100$
$1000 \div 100$	$2500 \div 100$	$20000 \div 100$

11. If 100 yards of cloth are sold for \$75, what is one yard worth?

12. If 100 dozen of eggs cost \$9, what is a dozen of eggs worth?

13. Read as thousands: 4689, 5000, 9000, and 12460.

14. How many thousands in each of the following numbers: 72000, 100000, 200000, 1000000, and 724689?

15. What do you do in order to divide any number by one thousand?

16. Find the value of:

$8000 + 1000$	$15250 + 1000$	$100001 + 1000$
$8960 + 1000$	$72100 + 1000$	$120120 + 1000$
$10200 + 1000$	$80900 + 1000$	$400500 + 1000$
$12000 + 1000$	$90009 + 1000$	$500659 + 1000$

17. If 1000 tons of coal cost \$10,000, what is coal a ton?

18. If 1000 bushels of wheat bring \$67,000, what is the wheat sold at per bushel?

19. What number divided by 10 gives as quotient 23 and a remainder of 7? What number divided by 100 gives as quotient 49 and a remainder of 73? What number divided by 1000 gives as quotient 348 and a remainder of 6? What number divided by 100,000 gives as quotient 26 and a remainder of 1481?

Exercise 42

1. If a number be divided by 3 and the result by 5, what has the number really been divided by?

2. If we divide a number by 7 and the result by 6, what have we divided the number by?

3. Dividing a number by 8 and the result by 5 is dividing the number by what?

4. To divide any number by 63 we have only to divide the number by — and the result by —.

5. To divide 7200 by 36 we have only to divide the number by — and then the result by —.

6. Examine the following solution:

$$\begin{array}{r|l} 7 & 456,435 \\ 9 & 65,205 \\ \hline & 7,245 \end{array}$$

What does 456,435 represent? What does 62,205 represent? What does 7245 represent? If 456,435 represented apples, what would 65,205 represent? What would 7245 represent? If we multiply 7245 by 63, what should the product be? Try this.

7. Examine this solution:

$$\begin{array}{r|l} 7 & 4741 \\ 6 & 677 - 2 \\ \hline & 112 - 5 \end{array}$$

How many groups of 7 are there in 4741? What remains? How many does this represent? How many groups of 42 are there in 4741? What remains? How many does this remainder represent?

8. What are 7 and 9 of 63? 7 and 6 of 42? 4 and 8 of 32? and 9 and 8 of 72?

9. Two factors of:

18 are — and —

20 are — and —

21 are — and —

24 are — and —

25 are — and —

Two factors of:

45 are — and —

63 are — and —

72 are — and —

56 are — and —

28 are — and —

10. Find, by the use of factors, the quotients and remainders in :

$$425 \div 18$$

$$1580 \div 35$$

$$4381 \div 72$$

$$730 \div 21$$

$$2720 \div 45$$

$$7620 \div 81$$

$$840 \div 24$$

$$3875 \div 63$$

$$9283 \div 56$$

$$456 \div 25$$

$$4860 \div 64$$

$$8778 \div 48$$

Exercise 43

When the divisor is a large number, it is necessary to write out in full most of the work. Where only the result is set down, the operation is called *short division*. When each step is set down, the operation is called *long division*. In our method so far results only have been given. We shall now show how to deal with such a question as :

Divide 7489 by 23.

Had we time we could rearrange 7489 as follows :

$$\begin{aligned} 7489 &= 74 \text{ hundreds} + 8 \text{ tens} + 9 \text{ ones} \\ &= 69 \text{ hundreds} + 58 \text{ tens} + 9 \text{ ones} \\ &= 69 \text{ hundreds} + 46 \text{ tens} + 129 \text{ ones} \end{aligned}$$

Therefore, $7489 \div 23 = 3 \text{ hundreds} + 2 \text{ tens} + 5 \text{ ones} + 14 \text{ ones of the } 7489 \text{ remaining.}$

$= 325$ as quotient and 14 as remainder.

The usual way of doing this is given below. It is only another way of saying that 7489 is equal to 69 hundreds + 46 tens + 129 ones :

23) 7489 (325 quotient

$$\begin{array}{r} 69 \\ \hline 58 \\ 46 \\ \hline 129 \\ 115 \\ \hline 14 \end{array}$$

NOTE. — The teacher should compare the two methods of division here.

L. Divide:

	7869 + 21	3567 + 31	5584 + 37
	7236 + 22	4876 + 33	4478 + 41
	1278 + 23	5393 + 35	3596 + 43
	66088 + 11	77066 + 11	330033 + 11
2.	4478 + 41	3456 + 52	6783 + 63
	2345 + 42	7482 + 54	4571 + 65
	6879 + 53	3952 + 61	7835 + 67
3.	5731 + 62	3454 + 73	4567 + 79
	4628 + 70	2643 + 75	5678 + 80
	7826 + 71	9876 + 77	6789 + 81
4.	8456 + 83	5735 + 89	4000 + 95
	5679 + 85	6357 + 91	7000 + 96
	4567 + 87	3575 + 93	9000 + 99
5.	4276 + 201	8430 + 131	10752 + 448
	5318 + 102	9012 + 173	20979 + 567
	3725 + 305	3705 + 237	47259 + 801
6.	35312 + 342	45678 + 157	90000 + 457
	44325 + 429	36870 + 453	89999 + 679
	73812 + 368	98765 + 782	97901 + 693
7.	14681 + 900	834697 + 135	974637 + 38
	72901 + 600	779319 + 616	400400 + 96
	479102 + 165	818191 + 462	630036 + 89

8. How often can \$78 be paid out of a purse containing \$1814? How often can \$36.18 be paid out of a purse containing \$1265.25? How often can \$323.70 be paid out of a purse containing \$2913.30?

9. What number besides 137 will exactly divide 11,371?

10. What is the smallest number which subtracted from 47,630 will make the result exactly divisible by 871?

11. I subtract 1676 from 20,112, then subtract 1676 from the result, and so on. How often can I do this?

12. How do you prove a question in division? Prove that when 94,635 is divided by 235, the quotient is 402 and the remainder 165.

Exercise 44

1. A man paid \$1455 for 15 horses. How much did he pay for each?

2. If 74 barrels of apples cost \$592, how much is this a barrel?

3. In 19 months Brown earned \$1083. Find his monthly wage.

4. There are 24 hours in one day. Express 17,616 hours as days.

5. How many quarters will pay a debt of \$17.75?

6. An excursion boat can carry 237 people. How many trips must be made to take 18,723 people?

7. I bought 32 pieces of cotton, each containing 38 yards, at 8 cents a yard, and paid for them with eggs at 24 cents a dozen. How many dozen did I give?

8. A man has \$4560 to expend in buying an equal number of oxen and horses. If he pays \$60 for the former and \$130 for the latter, how many of each could he buy?

SUGGESTION. — An ox and a horse cost how much?

9. If 13 men earned \$331.50 for 15 days' work, how much per day was that for each man?

10. A man having an income of \$3640 per year spent \$2000 and gave in charities \$600. How much per week has he saved? One year = 52 weeks.

11. I bought 624 barrels of flour at \$6 a barrel and sold it for \$4992. How much did I gain on each barrel sold?

12. If 63 articles cost me \$54.81, how much must I sell 29 of them for to gain \$1.45 on those sold?

13. Bought 900 pounds of wheat (60 pounds to the bushel) at 2 cents a pound and sold it at \$1.35 a bushel. Find my gain.

14. If I bought 80 turkeys at the rate of 8 for \$7, and sold them at the rate of 16 for \$15, how much did I make?

15. A market woman sold 7 lb. 4 oz. of butter at 32 cents a pound and took her pay in rice at 8 cents a pound. How many pounds of rice did she receive?

16. In a drove of 110 animals there are 40 cows, the rest are horses. How many horses must be sold that there may be left 5 horses for every 8 cows?

17. For 6 years a man spent \$3500 a year and found himself in debt. For the next 4 years he spent only \$2500 a year, and thus succeeded in paying off the debt? What was his income?

18. A man sold a number of horses which cost him \$2100 for \$2800, gaining thereby \$10 a head. What did each horse cost him?

19. If when labor is paid at the rate of 18 ct. an hour the cost of building a house be \$3600, what would be the cost if labor were paid at 16 ct. an hour? How long would a gang of 36 men working 10 hours a day take to build the house?

20. A fruit dealer purchased 24 boxes of oranges each containing 180 oranges. Freight and other expenses came to \$2.60. How much will he gain by selling the oranges at \$5 ct. a dozen, provided each box cost him \$2.15?

21. A man on a salary of \$28 a week pays \$7.50 a week for board and \$9.75 a week for other expenses. In how many weeks can he save enough to pay a debt of \$107.50?

22. If one quart of nuts costs 12 ct., how many bushels can be bought for \$61.44?

23. A grain dealer shipped 8500 bushels of wheat at a freight rate of 8 ct. per bushel. He sold the wheat at 87 ct. a bushel, gaining \$1615 on the total cost. How much did a bushel of wheat cost him in the first place?

24. Two trees stand on opposite sides of a road 60 feet wide. The height of one tree is to the width of the road as 2 to 3, and the width of the road is to the height of the second tree as 5 is to 2. Find the height of each tree.

25. I bought 4260 pounds of wheat at 85 ct. a bushel and 3468 pounds of oats at 27 ct. a bushel. How much had I to pay? One bushel of wheat weighs 60 pounds; one bushel of oats weighs 34 pounds.

Exercise 45 (Review)

1.	(a)	(b)	(c)	(d)	(e)
(1)	3847	2149	4356	1415	3843
(2)	8698	7224	1487	1817	8006
(3)	5479	3652	3776	1920	9645
(4)	2932	4875	4678	8761	4297
(5)	5756	1933	7797	3527	2932
(6)	4832	9618	9364	6338	6453
(7)	5836	4186	7459	8321	5256
(8)	5426	8414	9227	6484	2438
(9)	3482	7983	1463	7836	8928
(10)	7030	8749	6054	7489	1259
(11)	2139	7006	7448	2998	1045

Add the above horizontally and vertically, and sum the footings. If you can do this in 12 minutes, you are a fair adder. If not, you need a little more practice.

2. Subtract the following and prove your remainder.

43697201	75001070	400507003
28908938	67090982	239449444
<hr/>	<hr/>	<hr/>
6420073	33333333	37409261
5599839	25675769	28008979
<hr/>	<hr/>	<hr/>

3. Find the products of :

768	964	73456	48937
867	593	579	12345

4. Find the quotients of :

$$101436 \div 237$$

$$163048 \div 356$$

$$778743 \div 789$$

NOTE.— You are expected to work questions 2, 3, and 4 in 18 minutes.

5. Change :

- (a) 20 gallons to pints.
- (b) 3 bushels 2 pecks to pecks.
- (c) 7 feet 3 inches to inches.
- (d) 25 yards 2 feet to feet.
- (e) 5 weeks and 4 days to days.
- (f) 12 pounds and 8 ounces to ounces.

6. Change :

- (a) 456 pints to gallons.
- (b) 640 quarts to bushels.
- (c) 756 inches to yards.
- (d) 646 quarts to gallons and quarts.
- (e) 175 pecks to bushels and pecks.
- (f) 46 days to weeks and days.

7. Find the amounts of the following bills :

- (a) 2 lb. of tea @ 65¢.
2 gal. oil @ 35¢.
3 gal. molasses @ 65¢.
1½ lb. butter @ 28¢.
- (b) 12 yd. flannel @ 32¢.
9¼ dress goods @ 40¢.
3 yd. lace @ 63¢.
6 spools thread @ 5¢.
- (c) 13 lb. coffee @ 37¢.
37 lb. butter @ 25¢.
3 cans corn @ 13¢.
9 oranges @ 24¢ a doz.
25 lb. sugar @ 10 lb. for a dollar.

8. How many days from :

Mar. 9 to May 29?	May 13 to Aug. 20?
June 1 to Sept. 1?	Sept. 10 to end of Jan.?
Nov. 19 to Feb. 25?	April 3 to June 15?

9. A man worked every working day in the months of May and June. How much did he make at \$2 a day provided May 1st was Friday?

10. Add :

- (a) 9 gallons, 2 quarts, 1 pint, and 7 gallons, 3 quarts.
- (b) 7 bushels, 2 pecks, 7 quarts, and 6 bushels, 3 pecks, 5 quarts.
- (c) 12 yards, 2 feet, 9 inches, and 5 yards, 1 foot, 6 inches.

11. Subtract :

- (a) 16 bushels, 5 quarts from 18 bushels, 3 pecks, 4 quarts.
- (b) 7 yards, 1 foot, 7 inches from 20 yards.
- (c) 18 pounds 12 ounces from 20 pounds.

12. If I should have in my store 13 bushels 3 pecks and 4 quarts of potatoes, and should sell each customer a peck and a half, how many customers could be supplied?

13. If it takes $8\frac{3}{4}$ yd. to make a dress, how many yards will it take to make 12 dresses?

14. Add $\frac{1}{2}$ a dollar, 75 ct., $\frac{1}{4}$ of a dollar, $\frac{1}{5}$ of a dollar, and $\frac{3}{10}$ of a dollar.

15. At $\frac{1}{5}$ of a dollar a bushel, how much would 15 bushels of wheat cost?

16. If I should buy a peck of apples for 48 ct. and sell them for 64 ct., how much would I make on each quart?

17. Show that the result of dividing 71,428 by 7 and the quotient by 6 is the same as that obtained on dividing 71,428 by 42.

18. Express MMDCCLXXXIX in figures and in words.

19. What number multiplied by 86 will give the same product as 163 multiplied by 430?

20. Find the least number that must be added to 57,464 that the result may be exactly divisible by 429.

21. How often must 312 be added to 4321 that the sum may be 49,561?

22. Divide :

(a) $48 \times 15 \times 20$ by $12 \times 5 \times 4$.

(b) $63 \times 18 \times 42 \times 96$ by $9 \times 9 \times 7 \times 12$.

(c) $95 \times 105 \times 125 \times 150$ by $19 \times 35 \times 25 \times 50$.

23. A miller exchanged 48 loads of wheat, each containing 150 bushels, at 80 cents a bushel, for 16 loads of flour at \$4 a barrel. How many barrels were there in the load?

24. How many boards 8 feet long are there in a 4-board fence surrounding a field 432 feet long and 240 feet wide?



MICROCOPY RESOLUTION TEST CHART

ANSI and ISO TEST CHART No. 2



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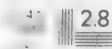
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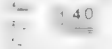
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25. Two dozen potatoes are placed 6 feet apart in a straight line, the first potato being 6 feet from a basket. How far will a boy travel who gathers them singly and places them in the basket?

26. A man sold 24 horses for \$150 each; on half of them he gained \$35 per head, and on the remainder he lost \$20 per head. Find the cost price of the horses and the total gain.

27. A postmaster is allowed one dollar and twenty cents on every twenty dollars' worth of stamps sold. How much will he make on a sale of 3000 two-cent stamps?

28. Bought 640 bushels of barley at the rate of 32 bushels for \$20.40 and sold it at the rate of 10 bushels for \$8.75. Find my gain or loss.

29. Work question (a) by addition and question (b) by subtraction:

(a) 4738×6 .

(b) $8448 \div 2112$.

30. One boy rises every morning at 5 A.M. and retires every evening at 10 P.M. Another rises every morning at 8 A.M. and retires every evening at the same hour as the former. How much time does the first boy gain over the second in the months of summer?

31. A loaned B \$9780. B repays A by giving him 24 head of cattle worth \$35 each, a farm worth three times as much as the cattle, and the balance in cash. How much cash was given?

32. A horse requires 3 gallons of oats a day. When oats are worth 40 cents a bushel, what will it cost to feed a team during the months of January and February?

33. A drover bought 494 sheep at \$6 each and 84 more at \$7 each. 18 of the flock died and the remainder were sold at \$7.25 each. What was the gain?

34. In making out a bill for 73 bushels of wheat at 60 cents per bushel I multiplied 73 by 60 and gave the result as \$43.80. Was I correct in my solution?

35. Bought oranges at 10 cents a dozen and sold them at the rate of 5 for 11 cents. How much was gained on 3 boxes each containing 20 dozen?

36. If I bought a pound of coffee at 45 cents, 3 dozen eggs at 24 cents a dozen, 3 pounds sodas at 15 cents a pound, 17 yards muslin at 15 cents a yard, 1 pound of tea at 33 cents, and the merchant threw off 10 cents of every dollar's worth bought, how much change should I get out of a ten-dollar bill?

MENSURATION

Exercise 46

1. Give a name to Figure A.
2. How many corners or angles has a square?
3. What do you call each of the angles of a square?
4. How many sides has a square? In what particulars do these sides agree?



FIG. A

5. What is the nature of the surface enclosed by the *edges*, *sides*, or *boundaries* of a square?
6. Can you draw a square on the surface of a sphere? on the curved surface of a cylinder? Is the surface of a square always *flat* or *plane*?
7. How many inches around the square shown in Figure A?
8. How do you distinguish this square from a square having 2 inches to a side? from one having a foot to a side? from one having a yard to a side?

9. If a cent is an inch in diameter, how many cents can you place on the surface of the square in Figure A? Does the cent cover the whole surface?

10. How many cents will cover the surface given below?



FIG. B

11. How long is Figure B? How wide? How many squares are marked on it? Did these help you to answer the number of cents necessary to cover this surface? How many squares are along the width? How many along the length? How many times will you have to take the squares along one side to get the 6 square inches? How many times will you have to take the squares along one end in order to get the 6 square inches? Do you know a way of finding how many square inches in any surface similar to the one given in Figure B? What is it?

12. Is Figure B a square? How does it differ from a square? In what way is it like a square? All such figures or forms are called *rectangles*. Is a square a rectangle? Are all rectangles squares?

NOTE. — A *plane* figure having four straight sides and four right angles is called a *rectangle*. A rectangle whose length is greater than its width is called an *oblong*.

13. Draw a 3-inch square and divide it into inch-squares. How many inch-squares are there? How many squares have you placed along a side? How many rows with 3 inch-squares to the row have you? Three rows with 3 inch-squares to the row make how many inch-squares?

14. Make a 6-inch square and divide it into square inches. How many inch-squares to a row have you? How many rows? Five rows with 5 inch-squares to a row cover how many *square inches*?

NOTE. — A square inch is the amount of surface enclosed by the sides or boundaries of an inch-square.

15. This is a picture of a square board divided by lines into small squares, each supposed to be one inch long and one inch wide. How many inches long is the board? How wide is it? How many squares are there on the upper edge? How many rows of squares? How many squares in the whole board? What do you call a square as large as Figure C? How many square inches in one *square foot*?

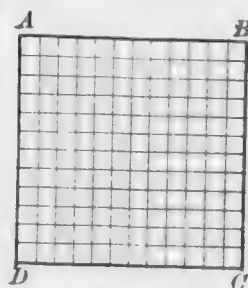


FIG. C

NOTE. — AB is only $\frac{1}{12}$ the length of the side of a foot-square.

16. Suppose that you can lay 6 books along the length of a table (books being placed endwise). Suppose, further, you can cover the table by placing four such rows, how many books can you lay on the table? How many times 6 books? How many times 4 books? How many books could you place on a table that is 7 times as long as the book and 8 times as wide as the book?

17. Draw, either on paper or on the blackboard, rectangles having:

- (a) The width 3 inches and the length 4 inches.
- (b) The width 4 inches and the length 5 inches.
- (c) The width 5 inches and the length 6 inches.
- (d) The width 8 inches and the length 9 inches.

18. Find the *areas* (amount of surface) of all the rectangles constructed.

SUGGESTION. — In a rectangle 5 inches by 6 inches, there are 6 rows with 5 inch-squares to a row, or 5 rows with 6 inch-squares in each. Six times 5 inch-squares = 30 inch-squares = 30 square inches.

19.

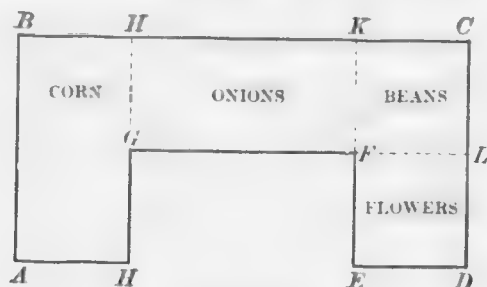


FIG. D

The diagram represents a child's garden. It is drawn to the scale of $\frac{1}{4}$ inch to 15 inches. The dotted lines show the divisions between the beds.

(a) Find how far it is from *A* to *B*; from *B* to *C*; from *C* to *D*; from *D* to *E*; from *E* to *F*, and from *H* to *A*.

(b) How many inches round the whole garden?

(c) What is the area of the bed of corn? what the area of the onion bed? what that of the beans? What is the area of the flower garden?

(d) Find the area of the whole garden. How much less is this than the area of *ABCD*?

Figure E is the diagram of a small room. It is drawn to the scale of one inch to every 24 inches. $EFGH$ is a rug placed on the floor. Find:

20.

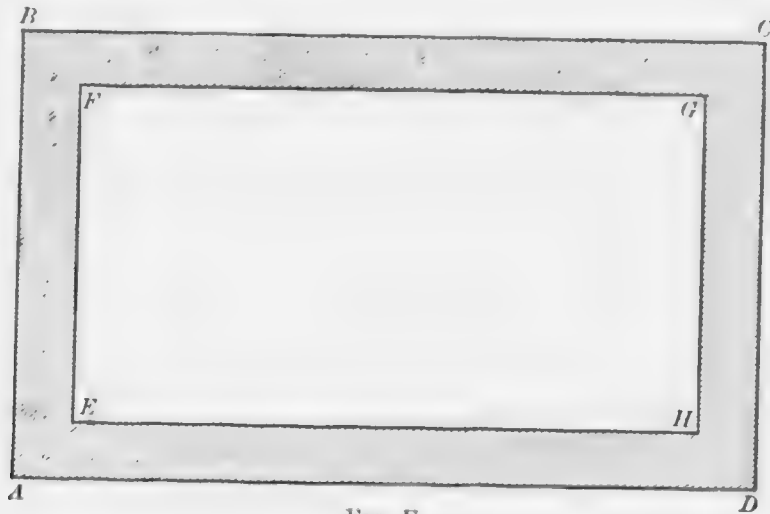


FIG. E

- (a) The length and the width of the room $ABCD$.
- (b) The length and width of the rug.
- (c) The width of the shaded border round the rug.
- (d) The area of the room; the area of the rug, and the area of the border.
- (e) How many carpet tacks placed 6 inches apart can be placed along the edge of the rug?

21. How many square inches are there in :

- (a) A square 8 inches long?
- (b) A square 15 inches long?
- (c) A square one foot 6 inches long?

22. How many square inches are there in an oblong :

- (a) 8 inches long and 6 inches wide?
- (b) 12 inches long and 5 inches wide?

- (c) 15 inches long and 13 inches wide?
- (d) 2 feet long and $1\frac{1}{2}$ feet wide?
- (e) 3 feet long and 2 feet wide?

23. How many times does a :

- (a) Four-inch square contain a 2-inch square?
- (b) Nine-inch square contain a 3-inch square?
- (c) Foot square contain a 6-inch square?
- (d) Foot square contain a 4-inch square?
- (e) Fifteen-inch square contain a 5-inch square?

Test the answers obtained in question 23 on the black-board.

24. How many times will an oblong :

- (a) 12 inches long and 8 inches wide contain a 4-inch square?
- (b) 15 inches long and 9 inches wide contain a 3-inch square?
- (c) 18 inches long and 12 inches wide contain a 6-inch square?

25. How many books each 6 inches long and 5 inches wide will it take to cover a table 36 inches long and 25 inches wide? Make a diagram showing how you would place the books on the table.

26.

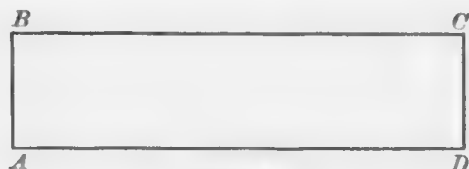


FIG. F

How many square inches in the rectangle shown in Figure F? Prove the correctness of your answer by making an exact copy of the plan (Figure F) on paper and cutting so as to show the number of square inches in its surface.

27. By how many square inches of glass is your school-room lighted?

28. A closed box is 3 feet long, 2 feet wide, and 15 inches deep. Find in square inches:

- (a) The area of each end.
- (b) The area of each side.
- (c) The area of the top.
- (d) The area of the bottom.
- (e) The total area of the box.

29.

(a) A slate 10 inches long has an area of 60 square inches. Find the width of the slate.

(b) A book 4 inches wide has an area of 20 square inches. Find its length.

(c) A page of foolscap is 13 inches long. Its area is 104 square inches. Find its width.

(d) A pane of glass is 24 inches long. Its area is 264 square inches. Find its width.

Exercise 47

1. B is a square 1 foot to the side. What do you call it? A is a square 3 feet or 1 yard to a side. What is A called?

NOTE. — The side of a yard square is 36 times a side of A .

2. How many square feet in 1 square yard? in 3 square yards? in 12 square yards?

3. In each square foot there are how many square inches? How many square inches are there in a square yard?

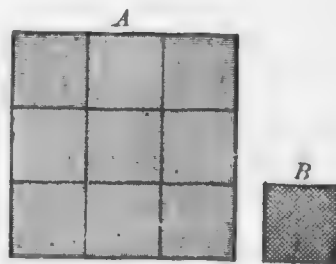


FIG. A

4. How many inches long is A ? How many inches wide? Find how many square inches in it. Is this result the same as that obtained in the second part of question 3?

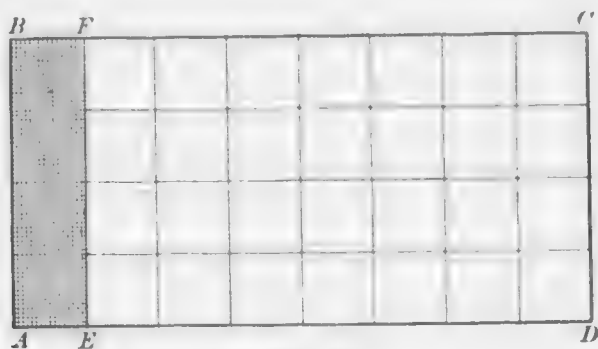


FIG. B

5. The rectangle $ABCD$ (Fig. B) is 8 feet long and 4 feet wide.

- (a) What is each square in Figure B called?
- (b) How many foot-squares do you find along the edge AB ?
- (c) How many such rows of squares do you find in the rectangle?
- (d) Eight rows with 4 square feet in each make how many square feet in the rectangle?
- (e) How many foot-squares do you find along the edge BC ?
- (f) How many such rows do you find in the whole rectangle?
- (g) Four rows each containing 8 square feet make how many square feet in the rectangle?
- (h) Do the results obtained in (d) and (g) agree?
- (i) Make a simple rule for finding the number of square feet in a rectangle. Will the rule hold for square inches? Should it hold for square yards?

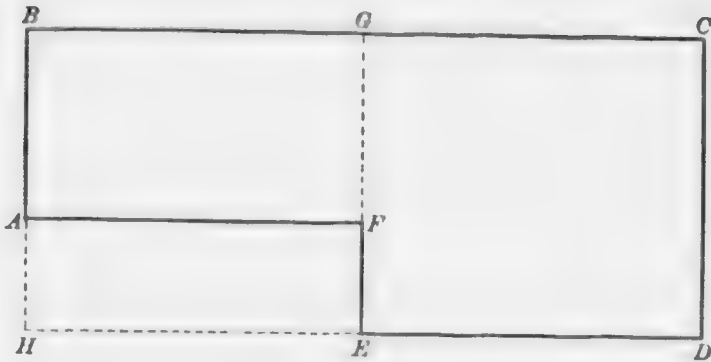


FIG. C

6. Figure C is the diagram of a lot. In it one-quarter of an inch represents 6 feet. Find:

- (a) How many feet round the lot?
- (b) How many yards round the lot?
- (c) What is the distance in feet from E to F ?
- (d) Which is the nearer way from A to C , by way of B , or by way of F ?

(e) If a boy could take a pace of 2 feet, how many paces would he take in following the border of the lot from F to F ? from D to D ?

(f) If fence-stakes or pickets were set three inches apart, how many pickets would have to be set to build a fence round the lot?

(g) How many square yards in the lot? how many square feet? How could you get the second answer from the first? the first from the second?

(h) Find both in square feet and in square yards the area of the rectangle CE (that is the rectangle $CDEFG$) and the area of the rectangle BF .

(i) How many square feet of land must the owner of this lot purchase in order to have a lot of the form $BCDH$?

7. Find in square feet the area of a square having a perimeter (sum of sides) of :

- | | |
|--------------|---------------|
| (a) 16 feet. | (d) 4 yards. |
| (b) 32 feet. | (e) 12 yards. |
| (c) 20 feet. | |

8. Find in square feet the area of an oblong :

- | | |
|------------------------|-------------------------|
| (a) 8 feet by 6 feet. | (c) 5 yards by 3 yards. |
| (b) 12 feet by 9 feet. | (d) 9 yards by 5 yards. |

9. Find in square yards the area of a room :

- | | |
|-------------------------|-------------------------|
| (a) 12 feet by 9 feet. | (c) 30 feet by 21 feet. |
| (b) 15 feet by 12 feet. | (d) 9 yards by 8 yards. |

10. (a) The area of a room is 108 square feet, the width is 8 feet, find the length.

(b) The area of a room is 180 square feet, the width is 12 feet, find the length.

11. (a) The area of a room is 15 square yards, the width is 9 feet, find the length.

(b) The area of a room is 42 square yards, the width is 18 feet, find the length.

(c) The area of a room is 270 square yards, the length is 54 feet, find the width.

12. How many square yards in a room :

- | | |
|-------------------------|-------------------------|
| (a) 18 feet by 12 feet? | (c) 24 feet by 21 feet? |
| (b) 15 feet by 15 feet? | (d) 30 feet by 27 feet? |

13. Make a simple rule for changing :

- | |
|----------------------------------|
| (a) Square yards to square feet. |
| (b) Square feet to square yards. |

14. Find the cost of painting the following floors at 15 cents per square yard :

- | |
|--|
| (a) A floor 15 feet long and 9 feet wide. |
| (b) A floor 24 feet long and 18 feet wide. |

15. How many square feet in :
- (a) A roll of carpet 60 yards long and 3 feet wide ?
 - (b) A roll of linoleum 18 yards long and 3 yards wide ?
 - (c) A rug 60 inches long and 48 inches wide ?
16. Compare the widths, heights, and areas of the opposite ends of the schoolroom.
17. Compare the lengths, heights, and areas of the opposite sides of the schoolroom.
18. Compare the lengths, widths, and areas of the floor and ceiling of the schoolroom.
19. Make a statement of what you have found to be true in the experimental questions 16, 17, and 18.
20. The following diagram represents the floor of a room 9 feet high :

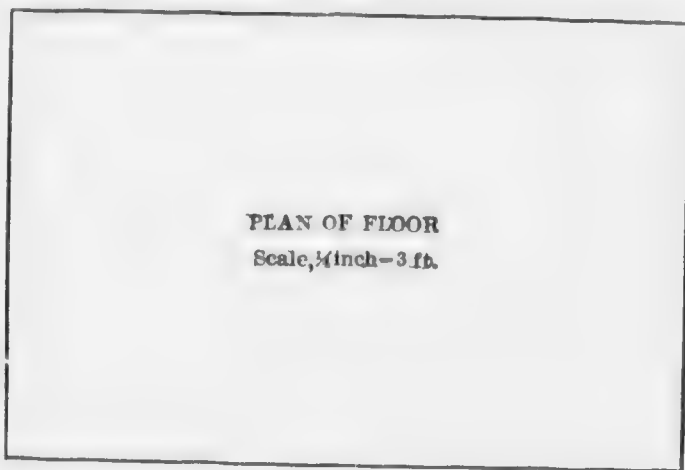


FIG. D

- (a) What is the length of the room ? its breadth ?
- (b) What is the distance round the room ? What name do you give this distance ?
- (c) What use did you make of the fact that the opposite ends have the same width and the opposite sides the same length ?

(*d*) If no account is made of the space covered by doors and windows, how many square feet of wall surface are there in this room? Which *dimension* (that is length, breadth, or height) is the same in ends and sides? Have you used this in obtaining your answer?

(*e*) If there were 6 windows, each 5 feet long and 3 feet wide, and a door 6 feet long and 3 feet wide, how much wall surface would be left?

(*f*) Find the area of the ceiling; of the floor.

21. A schoolroom 30 feet long and 24 feet high has 4 windows, each 6 feet by 3 feet, and a door 7 feet by 4 feet. The wainscoting is 3 feet high and goes round the room. All the rest of the wall and the entire ceiling is plaster. How many square feet of plaster are there, the room being 12 feet high?

SUGGESTION. — Make a plan of the room first.

22. How many bricks 8 inches long and 4 inches wide will be required to pave a room 48 feet long and 36 feet wide?

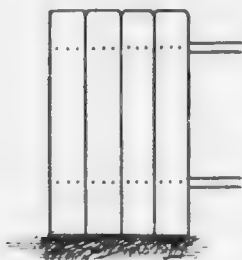


FIG. E

23. How many boards 12 feet long and a foot wide will be required to make a close fence 6 feet high enclosing a lot 80 feet long and 75 feet wide, the boards being placed as in Figure E?

24. If it costs \$5.70 to paint the floor of a room 9 feet long by 7 feet wide, what will it cost at the same rate to paint the floor of a room 36 feet long and 28 feet wide?

SUGGESTION. — The second floor is how many times as large as the first floor?

Exercise 48

NOTE. — A side of a square rod is 106 times the side of this square.

$ABCD$ is a square $5\frac{1}{2}$ yards to a side. $BE, EF, FG, GH, HL, BM, MN, NP, PQ,$ and QR are each one yard, while

LC and RA are each $\frac{1}{2}$ yard, or 1 foot 6 inches. The length, $5\frac{1}{2}$ yards, is used in measuring great distances and the square, $5\frac{1}{2}$ yards to a side, is used in measuring large areas. The length, $5\frac{1}{2}$ yards, is called a *rod* and the square, having

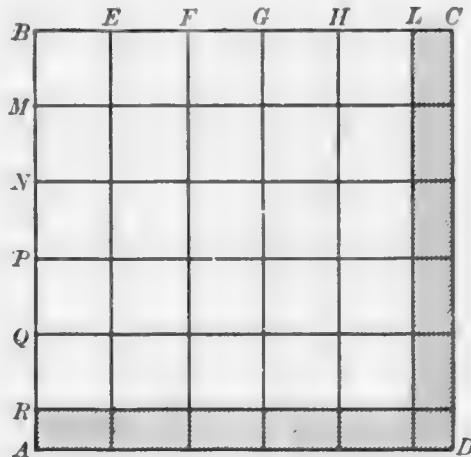


FIG. A

each side $5\frac{1}{2}$ yards, the *square rod*. To know how great a surface a square rod covers, mark out a square rod on the school floor, or on the playground.

1. How many feet in $5\frac{1}{2}$ yards? Preserve the result.
2. Get a tape-line and measure how many feet in width the road allowance or street is.
3. Measure off rods on a string.

Knot the string to show where 1 rod, 2 rods, 3 rods, etc., are placed. With this measuring line, find the width of the street or the road allowance in rods.

4. Find from Figure A how many square yards in a square rod. Try to remember what you have found and how it was found.

5. A mile is 320 rods. How many yards in a mile?

SOLUTION :

In 1 rod there are $5\frac{1}{2}$ yards.

In 320 rods there are 320 times $5\frac{1}{2}$ yards,

or 320 times 5 yards + 320 half yards,

or 1600 yards + 160 yards,

or 1760 yards.

6. How many feet in a mile?

Obtain answers by using the number of feet in a rod, question 1, and also by using the result of question 5.

One mile is equal to — rods, or — yards, or — feet.

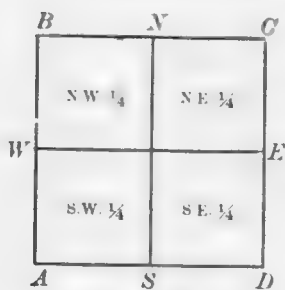


FIG. B

7. Figure B represents a mile square or *section* of land and the four quarter-sections.

(a) How long is a section? Give answer in miles, rods, yards, and feet.

(b) What part of the whole section is the N.W. $\frac{1}{4}$? S.E. $\frac{1}{4}$? N.E. $\frac{1}{4}$? S.W. $\frac{1}{4}$?

(c) What is the shape of each quarter-section?

(d) How long is a quarter-section? Give answer in miles and in rods.

(e) Which quarters make the north half of the section? the east half of the section?

(f) How many square rods in a section? in a quarter-section? in a half-section?

8. A plot of ground is 8 rods long and 6 rods wide. How many square rods in its surface? Make a diagram, taking 1 inch equal to 2 rods, and prove your answer by dividing the rectangle into rod-squares.

9. A man bought the S.E. $\frac{1}{4}$ of a section. Show from a plan drawn on the blackboard where the land is in the section. How many rods of fencing will go round this

farm? How often would one have to walk around the quarter-section to walk 20 miles?

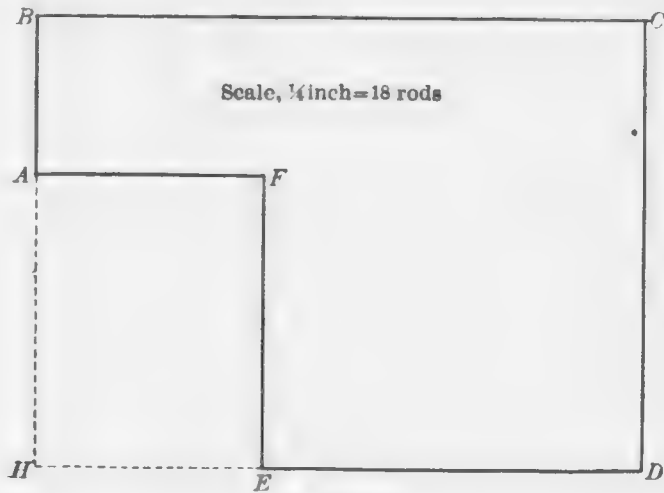


FIG. C

10. (a) How many rods is it round the lot in Figure C?
- (b) What is the distance in yards from A to B ? from A to F ? from E to D ?
- (c) How far is F from C across the lot? How far round by A ? by E ?
- (d) If you can take a step of 3 feet, how many steps would you have to take to go round the lot?
- (e) If fence posts were set every 6 feet, how many posts would be required?
- (f) What is the area of AE in square rods?

11. Find in square rods the area of:

- (a) A piece of land $\frac{1}{2}$ a mile long by $\frac{1}{4}$ of a mile wide.
- (b) A piece of land $\frac{1}{4}$ of a mile long by $\frac{1}{16}$ of a mile wide.
- (c) A piece of land $\frac{3}{8}$ of a mile long by $\frac{5}{16}$ of a mile wide.
- (d) A piece of land $\frac{1}{4}$ of a mile long by $\frac{3}{8}$ of a mile wide.
- (e) A piece of land $\frac{7}{10}$ of a mile long by $\frac{2}{5}$ of a mile wide.

12. Find in rods the perimeters of (*a*) and (*b*) of question 11.

13. Find in inches the perimeters of (*b*) and (*c*) of 11; in yards, the perimeters of (*c*) and (*d*), and in feet, the perimeters of (*d*) and (*e*).

14. Draw on the blackboard plans of (*a*) and (*d*). Scale 3 inches = 40 rods.

15. A man owned four lots of the following dimensions:

No. 1. 8 rods by 12 rods.

No. 2. 15 rods by 20 rods.

No. 3. 24 rods by 30 rods.

No. 4. 36 rods by 48 rods.

Find:

(*a*) The total area of Nos. 1, 2, 3, and 4.

(*b*) The total value at \$1 per 12 square rods.

(*c*) The selling price provided he sold the lots at \$3 for every rod of width in the lots.

(*d*) The length of a lot whose area is the sum of the areas of Nos. 1, 2, 3, and 4, and whose width is 36 rods.

16. (*a*) How many yards to a mile? how many chains?

NOTE.—In measuring large areas surveyors make use of a *chain* of one hundred links. The length of this chain is 22 yards.

(*b*) What is the length of a chain in rods? in feet? in inches?

(*c*) How many inches long is a link? Make a drawing of a link of a surveyor's chain on the blackboard.

(*d*) What part of a chain is 50 links? 70 links?

(*e*) Change $\frac{1}{3}$ of a chain to feet and 5 chains to rods.

(*f*) Find the width of the street in chains.

NOTE.—In order to make the chain of real value, it is suggested that each teacher be provided with a piece of strong twine to represent this measure. Such twine may have loops at each end, may be divided into 100 equal parts (almost 8 inches to a link) to show the

links, and into 4 equal parts to show rods. The ends of links and rods may be shown by twisting colored thread round the twine. Use such a chain wherever and whenever there is opportunity.

17. How many chains in: How many feet in:
- (a) 1320 feet? (a) 7 chains?
- (b) 1584 inches? (b) 300 links?
- (c) 5280 yards? (c) 1 mile 3 chains?
18. What part of a mile is:
- (a) 16 chains?
- (b) 40 chains?
- (c) 64 chains?

Exercise 49

1. The block shown in Figure A is an inch high, an inch long, and an inch wide. What is its name? How many sides, faces, or surfaces has it? What is the shape of each face? How many *solid* corners or angles has it? How many straight edges or straight lines has it?

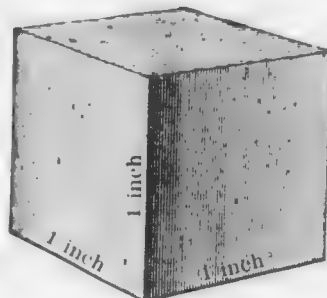


FIG. A

2. What name would you give to Figure A were each side a foot long? Each side a yard long? Each side 6 inches long? Each side 2 feet long?

NOTE. — A cubic inch is the amount of space or room taken up by an inch-cube.

3. If 4 cubes are set in a row, and 3 more rows are set beside them, how many cubes will there then be together?

4. How many inch-cubes can be placed side by side along the length of a table 3 feet long? How many such rows could be placed provided the table were 2 feet wide? How many inch-cubes would there be on the table?

5. How many inch-cubes will cover a table 18 inches long and 15 inches wide? If another layer of inch-cubes were placed on top of the first, how many cubes would be on the table? if 3 layers? if 7 layers? if 12 layers?

6. How many inch-cubes can be placed on a board a foot square? How many inch-cubes would be required for two such layers? for 3? for 6? for 9?

7. If 12 layers of inch-cubes were placed on the board mentioned in question 6, how high would the pile stand? What would be the shape of it? How many cubic inches in a cubic foot? Preserve this number for future reference.

8. How many cubic inches in:

- (a) A four-inch cube?
- (b) A seven-inch cube?
- (c) A cube 15 inches?
- (d) A cube 20 inches?
- (e) A cube 1 foot 3 inches?

9. How many cubical blocks an inch long would be required to cover a rectangle 4 inches long and 2 inches wide? If another layer

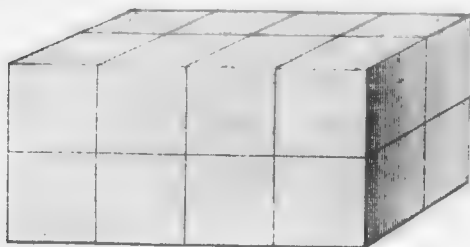


FIG. B

were placed on top of these, how many inch-cubes would there be in all? Such a body is Figure B. It has length, breadth, and height. Its corners are all square and

its faces are all rectangles. Any solid body whose corners all form right angles is called a *rectangular solid*.

10. How many cubic inches are there in rectangular solids of the following dimensions:

- (a) 8 inches long, 4 inches wide, and 3 inches thick?
- (b) 12 inches long, 10 inches wide, and 5 inches thick?
- (c) 15 inches long, 12 inches wide, and 10 inches thick?
- (d) 18 inches long, 15 inches wide, and 12 inches thick?
- (e) 2 feet long, 1 foot wide, and 6 inches thick?

11. A tin water-tight box is 8 inches deep. Its bottom is 5 inches square. How many cubic inches of water will it contain? How many cubic inches of sand?

12. A box 12 inches deep, 8 inches long, and 6 inches wide when filled 12 times with sand will empty a second box. How many cubic inches of space in the second box?

13. What is a foot-cube? How much space does a foot-cube occupy?

14. How many foot-cubes can be placed in one layer on a board a yard square? How many cubes in two such layers? In three such layers? What form would be built by placing 3 layers of foot-cubes on a board a yard square? How many cubic feet in a cubic yard? Preserve this number.

15. How many cubic feet in a block of stone:

- (a) 5 feet long, 3 feet wide, and 1 foot thick?
- (b) 7 feet long, 4 feet wide, and 3 feet thick?
- (c) 10 feet long, 2 feet wide, and 2 feet thick?
- (d) 12 feet long, 3 feet wide, and 3 feet thick?
- (e) 20 feet long, 4 feet wide, and 5 feet thick?

16. How many cubic yards of air in a room:

- (a) 12 feet long, 9 feet wide, and 9 feet high?
- (b) 15 feet long, 12 feet wide, and 9 feet high?
- (c) 18 feet long, 15 feet wide, and 12 feet high?
- (d) 24 feet long, 21 feet wide, and 15 feet high?
- (e) 30 feet long, 27 feet wide, and 18 feet high?

17. How many blocks, each 1 foot long, 9 inches wide, and 6 inches thick, can be placed in one layer on a floor 12 feet long and 9 feet wide, if:

- (a) The blocks are placed on their ends?
- (b) The blocks are placed on their edges?
- (c) The blocks are placed on their faces?

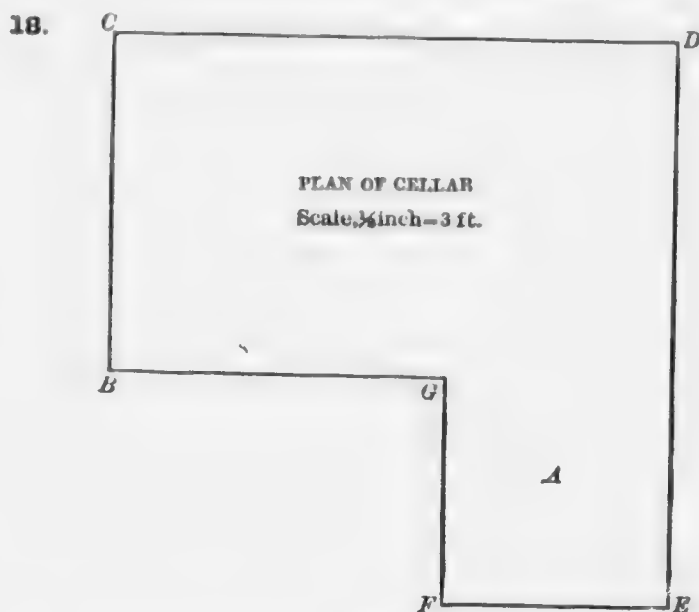


FIG. C

- (a) Find the distance round the cellar in Figure C.
- (b) What is the area of the cellar floor?
- (c) How many square feet in the smaller extension A?
- (d) If the cellar is to be dug 6 feet deep, how many cubic feet of earth will be taken out?
- (e) How many cubic yards?

19. Why had you to know the surface of $BCDEFG$ before you could determine (d), question 18?

20. How many cubic feet in:

(a) A stone wall 20 feet long, 2 feet thick, and 7 feet high?

(b) A block of ice 4 feet long, 3 feet thick, and 4 feet wide?

(c) A pile of wood 40 feet long, 6 feet high, and 4 feet wide?

Exercise 50

NOTE. — When wood is cut for market the sticks are, as a rule, 4 feet in length. A pile of such wood 4 feet high and 8 feet long contains a *cord*.

1. How long is a cord?
How wide? How high?
How many cubic feet? Preserve this for future reference.

2. How many cubic feet in half a cord? In a quarter of a cord? In 3 cords?

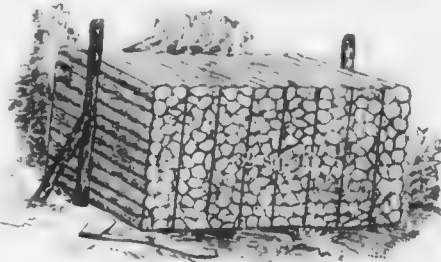


FIG. A

3. A pile of wood is 40 feet long, 4 feet wide, and 4 feet high. How many cords does it contain? Obtain the result in two ways.

4. A pile of stone is 56 feet long, 8 feet wide, and 4 feet high. How many cords of stone does it contain. Obtain the result in two ways.

5. A pile of wood is 80 feet long, 8 feet high, and 4 feet wide. How many square feet of surface are there on one side of this pile? How many cords of wood in the pile? Obtain answer to this question in three different ways.

6. A pile of cord-wood is 64 feet long and 12 feet high. How many cords in it?

7. There are three piles of wood in a wood yard. The dimensions of the first are 72 feet, 6 feet, and 4 feet; of the second, 88 feet, 7 feet, and 4 feet; and of the third, 48 feet,

8 feet, and 4 feet. What is the wood in the yard worth at \$5 a cord?

8. A man ordered 3 cords of poplar wood. When the wood was delivered, he found the pile measured 20 feet in length and 4 feet in height. How much less than he ordered was delivered?

9. One man drew a quarter of a cord of gravel. Another a cubic yard of gravel. Find in cubic feet the difference between the loads.

10. How many cords in:

- (a) A pile 128 feet long, 6 feet high, and 4 feet wide?
- (b) A pile 104 feet long, 8 feet high, and 6 feet wide?
- (c) A pile 136 feet long, 12 feet high, and 8 feet wide?

11. A pile of wood $\frac{1}{3}$ of a mile long, 12 feet wide, and 10 feet high is being shipped by train. How many trains, each pulling 25 cars, will be required to carry the wood provided each car takes 10 cords? How many cords of 2-foot (stove) wood would this pile make?

Exercise 51

1. Figure A is the ground-plan of a village lot.

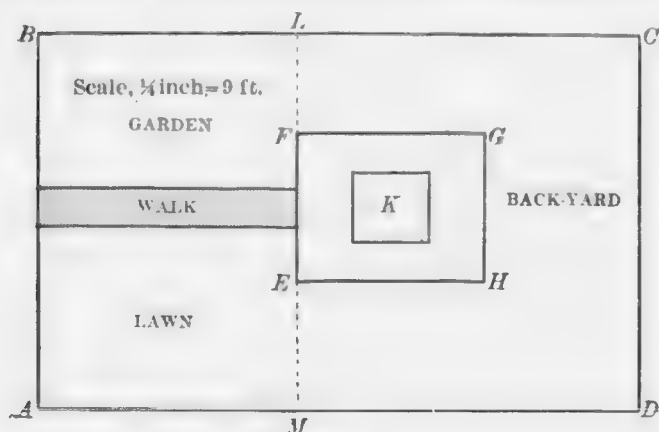


FIG. A

Find, from the foregoing diagram :

(a) The length and breadth of the lot, house, walk, and cellar. (*K* is the cellar.)

(b) What is the area in square feet of the lot? Of the house? Of the cellar? Of the walk? Of the back yard? Of the lawn? Of the garden?

2. Find the cost of :

(a) Digging the cellar (Fig. A) at \$3 per cubic yard.

(b) Laying the walk at 75 ct. per foot in length.

(c) Building the fences between the front and back yards at \$1.25 per foot in length.

(d) Building the fence surrounding the lot, at 6 ct. per dozen pickets, the pickets to be placed 3 inches apart.

(e) Sodding the lawn at the rate of 40 ct. per square yard.

(f) Digging the garden at the rate of 3 ct. per square yard.

3. A piece of cloth when measured by a yardstick 6 inches short, appears to be 60 yards in length. What is its actual length?

4. A garden is 66 feet long and 33 feet wide, find :

(a) Its area in square feet.

(b) Its area in square yards.

(c) Its area in square rods.

5. Make a plan of the garden in question 4, and place around it a walk 2 feet wide.

(a) What scale did you use?

(b) What is the area of the walk in square feet?

6. I traded a piece of land 64 rods wide for an equal area 400 rods long and 80 rods wide. Find the length of the first piece of land.

7. The distance round a rectangle is 400 feet. The length is 40 feet greater than the breadth. Find the number of square feet in the rectangle.

8. How many blocks of stone one foot long, 6 inches wide, and 4 inches thick, will be required to cover a floor 24 feet long and 18 feet wide, the stones being laid on their faces?

9. An ice-house contains 80 tiers of ice. In each tier there are 49 blocks, each 3 feet long, 2 feet wide, and 2 feet thick. If a cubic foot of ice weighs 58 pounds, find the total weight of ice in the building.

10. How many 2-inch cubes can be packed in a box 18 inches long, 14 inches wide, and 10 inches deep?

11. What is the difference between :

(a) A 6-inch cube and 6 cubic inches?

(b) A 2-yard cube and 2 cubic yards?

(c) A 10-foot cube and 10 cubic feet?

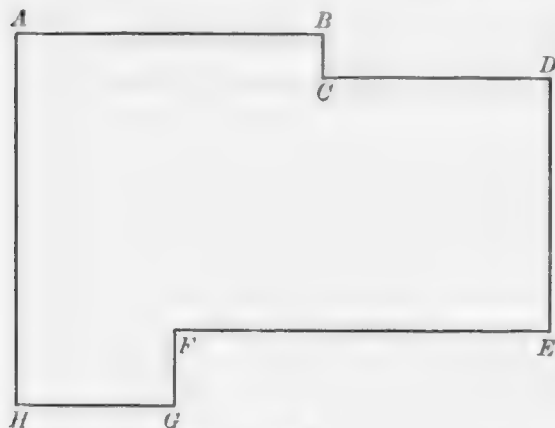


FIG. B

12. Figure B represents a lot of land. The scale is $\frac{1}{4}$ of an inch to 9 rods.

Find:

(a) The distance round in yards.

(b) The area in square rods.

(c) Which would cost the less, and how much less, to build a stone wall 3 feet wide and 6 feet high across the west end of this lot, at 80 cents per cubic yard, or at \$8 per rod in length?

Exercise 52 (Review)

1. The thermometer now stands at the freezing-point of water. How much must it fall to stand at 3° above zero?

2. Make a diagram of the face of a clock, showing how the hands stand at:

(a) Fifteen minutes to six.

(b) Fifteen minutes past six.

(c) Half past seven.

(d) Four o'clock.

(e) Twelve o'clock.

3. I spent $\frac{3}{4}$ of my money in buying flour, and the remainder in buying 12 pounds of butter at 30 ct. a pound. What did the flour cost me?

4. The difference between 7 times my age and 4 times my age is 24 years. How old am I?

5. Three boxes are filled with nuts. The first contains $\frac{3}{4}$ as much as the second, and the third contains $\frac{1}{2}$ as much as the second. Find the number of bushels of nuts if the third contains 32 pints of nuts. Find also the value at \$3 a bushel.

6. If $7\frac{1}{2}$ acres of land can be ploughed for \$15, what will it cost to plough a quarter-section (160 acres) of land?

7. How many sheep can be bought for \$120 at the rate of 3 sheep for \$20?

8. If 3 men can dig a ditch a quarter of a mile long in 12 days, in what time can 6 men dig the same ditch? 12 men?

9. I bought a horse and a carriage for \$360. The horse cost me three times as much as the carriage. Find the cost of each.

10. A man having a certain sum of money spent \$3, and afterwards earned \$8. He now has \$25. How much had he at first?

11. I bought 100 bushels of potatoes at 60 ct. a bushel. I sold $\frac{2}{5}$ of the potatoes at 96 ct. a bushel, $\frac{1}{4}$ at \$1.05 a bushel, and the remainder at \$1.20 a bushel. Find my gain.

12. What will 5 lb. 5 oz. of butter cost at 32 ct. a pound?

13. If milk costs 8 ct. a quart, and I take one quart and a pint of milk a day, what will my milk bill be in January? in June?

14. Find the amount of the following bill:

63 pounds of butter at 23 ct.

17 pounds of bacon at 17 ct.

18 pounds of tea at 65 ct.

7 $\frac{1}{2}$ dozen eggs at 20 ct.

$\frac{3}{4}$ of a dozen oranges at 24 ct.

4 lead pencils at 30 ct. a dozen.

15. Robert Hall's crop for 1904 amounted to 15,000 bushels of wheat, 3000 bushels of oats, and 1760 bushels of barley. He sold $\frac{2}{3}$ of the wheat at 75 ct. a bushel, and $\frac{1}{5}$ at 86 ct. a bushel. He sold $\frac{3}{4}$ of the oats at 45 ct. a bushel, and all the barley at 55 ct. a bushel. His expenses were \$1100. How much did he make?

16. At what rate must one walk to reach home by 4 P.M. if one is now 30 miles away and the hour is 10 A.M.?

17. A tea merchant mixed 18 pounds of tea worth 60 ct.

a pound with 10 pounds worth 42 ct. a pound. He sold the mixture at 57 ct. a pound. How much did he gain or lose?

18. A man bought a binder for \$120, a plough for \$24, and a wagon for \$80. He gave in payment \$52 in cash and 224 bushels of wheat. At what price did he sell wheat?

19. The divisor is 364, the quotient is $\frac{3}{4}$ of the divisor, and the remainder is $\frac{2}{3}$ of the quotient. Find the dividend.

20. Two boys 300 miles apart set out on their bicycles to meet each other. One rides at the rate of 7 miles an hour, the other at the rate of 8 miles an hour. How long before they will meet? How many miles will each have ridden?

BOOK I. — PART II

REVIEW

Exercise 1

1. Read: 72348960, 120843, 40201, and 30000001.
2. Read: MMDLX, CMV and CDLXX.
3. Write in figures: four hundred and eight thousand, two hundred and eleven; seventeen million, ten thousand and one; nine hundred and three thousand, two hundred and fifty-six.
4. Write in Roman letters: 75, 750, 1904, and 999.
5. Find a meaning for \overline{M} ; \overline{CC} ; \overline{XC} ; and \overline{X} .
6. In the number 555, give the value of the first 5 commencing at the left; of the second; of the third.
7. When we write \$39.72 the 3 stands for how many dollars? The 9 for how many dollars? The 7 for how many dollars? The 2 for how many dollars?

8. Add at sight:

47 + 53	63 + 28	71 + 19	22 + 23 + 24
76 + 14	44 + 39	93 + 20	31 + 32 + 33
32 + 25	49 + 24	37 + 41	18 + 19 + 37

9. Subtract at sight:

86 - 36	95 - 17	72 - 13	120 - 50
48 - 18	87 - 18	84 - 17	150 - 70
72 - 32	43 - 16	90 - 18	180 - 60

10. Multiply at sight:

37×2	36×4	25×8	30×5	13×7
49×2	75×6	25×20	40×3	16×5
17×5	25×4	25×24	49×2	32×5

11. Divide at sight:

$48 \div 3$	$96 \div 24$	$120 \div 15$	$91 \div 13$
$75 \div 5$	$96 \div 12$	$72 \div 18$	$87 \div 29$
$75 \div 15$	$96 \div 16$	$60 \div 15$	$57 \div 19$

12. Find the following results mentally:

- (a) How many weeks in 364 days?
- (b) If 25 cents can buy 3 pounds of berries, what can I buy for \$1.25?
- (c) How many oxen can be bought for \$219 at \$73 each?
- (d) At 24 cents a pound, how many ounces of butter will 18 cents buy?

Exercise 2

1. Add the following without using columns:

- (a) \$7.36, \$9.14, \$546.25, \$327.93, \$14.21.
- (b) \$8.43, \$3.60, \$42.23, \$729.45, \$0.37.
- (c) \$74.80, \$96.55, \$27.81, \$184.75, \$66.80.
- (d) \$202.35, \$804.90, \$77.95, \$248.68, \$330.00.

2. Add:

\$3460.38	\$ 13.95	\$ 48.35
725.95	638.70	46.90
4405.84	4293.85	347.36
378.96	9.77	7248.11
27.50	8.30	453.75
9723.85	67.58	835.50
.75	9200.05	1985.80
<hr/>	<hr/>	<hr/>

3.	9437	4455	7227	6655
	2689	—	8464	7788
	9475	6898	9375	9301
	8834	7246	—	4684
	—	8391	4238	9723
	6997	8448	6697	4691
	2483	6676	8209	—
	9716	9875	7008	9875
	57059	60000	55585	56000

4. Multiply :

7689×7689	5280×176	4637×89
6745×5616	1760×320	7208×76
4603×7000	1728×144	6648×54

5. Divide :

64347 by 723	216225 by 465
73950 by 986	231792 by 528
53988 by 818	193400 by 967

6. At 25 cents each, find the cost of :

- | | |
|--------------------------|-------------------------|
| (a) 64 books. | (d) 12 dozen bananas. |
| (b) 72 pounds of coffee. | (e) 48 bars of soap. |
| (c) 36 yards of ribbon. | (f) 47 pounds of candy. |

7. At 25 cents each, how many :

- (a) Pounds of coffee can be bought for \$3.75?
 (b) Pounds of tea can be bought for \$10.25?
 (c) Pairs of scissors can be bought for \$7.50?
 (d) Pairs of cuff-buttons can be bought for \$1.75?

8. At :

- (a) \$1.89 per yard, find the cost of one foot of silk.
 (b) 32 cents per pound, find the cost of 4 pounds, 2 ounces of butter.
 (c) 96 cents for 24 pounds, how much flour can I buy for 60 cents?

Exercise 3

1. What is a square foot? A cubic yard? A cord?
2. Find :
 - (a) The area of a rectangle 75 ft. by 60 ft.
 - (b) The distance round a 35-foot square.
 - (c) The area in square yards of an 18-foot square.
3. How many square yards in :
 - (a) A rectangle 45 feet by 36 feet?
 - (b) A rectangle 48 feet by 27 feet?
4. What is the length of a chain in yards? In feet?
5. How long is a rod in yards? In feet?
6. How many square yards in a square rod?
7. A lot is 6 rods long and 4 rods wide ; how many square yards in it? Square rods?
8. How many square rods in a field 8 chains long and 6 chains wide?
9. A stone is 10 feet high, 6 feet wide, and 5 feet thick. How many cubic feet in it?
10. How heavy is a stone 8 feet by 6 feet by 3 feet if a cubic foot weighs 96 pounds?
11. How many bricks 8 inches long, 4 inches wide, and 2 inches thick can you place in a box 8 feet long, 4 feet wide, and 2 feet deep?
12. How many cubic feet of air in a room 27 feet long, 18 feet wide, and 15 feet high? If the floor of this room be covered 3 feet deep with sawdust, how many cubic feet of air will still be in the room?
13. How many cords of wood in a pile $\frac{1}{8}$ of a mile long and 12 feet high?

14.

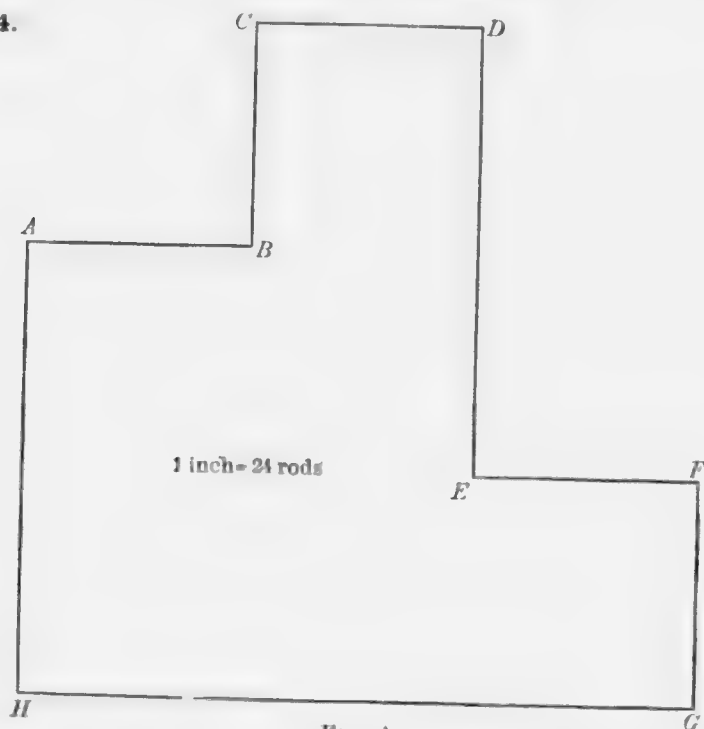


FIG. A

The field in Figure A was at one time a square, but the owner sold a piece from the north-east corner and another piece from the north-west corner. How many square rods did it contain at first? How many now? How many square rods are there in the northern extension? How many in the south-eastern extension? How many fence posts placed 6 feet apart will be required to enclose this field?

Exercise 4

1. A boarding-school uses 3 quarts of milk a day for 9 pupils. If there are 240 pupils in the school, how much will the milk bill be at 20 cents a gallon?
2. I bought 27 pounds of coffee at 35 cents a pound, and 3 times as much tea at 65 cents a pound. What change should I get out of seven 10-dollar bills?

3. A woman sold $19\frac{1}{2}$ dozen eggs to one householder, $7\frac{3}{4}$ dozen to another, $8\frac{5}{8}$ dozen to a third, and $6\frac{2}{3}$ dozen to a fourth. How much did she receive if eggs are worth 24 cents a dozen?

4. A butcher bought an ox weighing 1200 pounds at 7 cents a pound. When killed and dressed, its weight was $\frac{3}{4}$ of the live weight. How much is made if the butcher sold the meat at 18 ct. a pound?

5. The weight of a tub of butter, including the tub, is $48\frac{1}{4}$ pounds. The tub weighs 152 ounces. What is the butter worth at 24 ct. a pound?

6. One man had \$17.65, a second \$18.30, a third \$24.60, and a fourth \$23.25. They agree to divide this evenly among the four. Find how much each will then have.

7. A man divided 200 apples among 8 boys. He gave $\frac{1}{4}$ of them to the first, $\frac{1}{5}$ of the remainder to the second, and the balance he divided equally among the rest. How many did each of the latter receive?

8. I bought $3\frac{1}{2}$ pounds of coffee at 32 cents a pound and $1\frac{1}{2}$ pounds of tea at 60 cents a pound. What had I to pay?

9. A grocer sold 2 pounds 3 ounces of butter for 70 cents. What was this a pound?

10. A woman pays \$5.20 for 3 pounds of tea and 56 pounds of sugar. The tea costs 80 cents a pound; what did the sugar cost?

11. A man having \$7500 paid $\frac{2}{3}$ of it for a house, \$438.90 for repairs, and \$396 for furniture. How much money had he left?

12. Find the cost of the following bill :

64 pounds of sugar at 16 pounds for a dollar.

18 oranges at 24 cents a dozen.

17 pounds of butter at 3 pounds for 63 cents.

28 pounds of lard at 12 cents.

13. Eight pounds of black tea are mixed with 12 pounds of green tea and sold at 60 cents a pound. Find the gain, having given that the black tea costs 35 cents a pound and the green tea 50 cents a pound. What did one pound of the mixture cost?

14. A workman deposited in the bank \$35 a month for 11 months, and \$20 the twelfth month. His expenses amounted to \$3 a day. Find his daily wages for the 200 days he has worked.

15. A boy hired a boat at 20 cents an hour. How much had he to pay if he used it from 20 minutes before 9 A.M. until 10 minutes past 2 P.M.?

16. On June 21st the sun was seen to rise at 4.30 A.M. and to set at 7.50 P.M. How long was the night?

17. Change:

- (a) 15 pounds and 4 ounces to ounces.
- (b) 16 gallons and 3 quarts to pints.
- (c) 3 pecks and 2 quarts to quarts.
- (d) 4 rods to yards.
- (e) 30 pints to quarts.
- (f) 228 inches to feet.

18. A board fence 6 feet high surrounds a lot 30 feet frontage by 240 feet in depth. How many square feet of boards in the front fence? In the back fence? In each side fence? In the whole?

19. A room is 20 feet long, 15 feet wide, and 12 feet high. How many square feet in the floor? In the walls? In the ceiling?

20. Bought 10 boxes of oranges each containing 20 dozen at \$1.60 per hundred oranges and sold at the rate of 20 cents per dozen. Find the profit or loss.

WEIGHTS AND MEASURES

Exercise 5

AVOIRDUPOIS WEIGHT

16 ounces (oz.) = 1 pound (lb.).

100 pounds = 1 hundredweight (cwt.).

2000 pounds = 1 ton (T.).

NOTE. — Avoirdupois weight is used in measuring all common goods, such as sugar, hay, coal, grain, salt, etc. See Appendix A.

1. Find the cost of :
 - (a) $25\frac{1}{2}$ lb. of butter at 28 ct. per lb.
 - (b) 240 lb. raisins at 11 ct. per lb.
2. What will :
 - (a) 3 lb. 4 oz. of lard cost at 20 ct. per lb. ?
 - (b) 320 oz. of cheese cost at 12 ct. lb. ?
3. How many pounds in 3 cwt. ? In 5 cwt. ? What does hundredweight mean ?
4. What will 250 lb. of seed wheat cost at \$4 per hundredweight ?
5. Ten barrels of potatoes contain 1650 lb. How many bushels of potatoes (60 lbs. to the bushel) in one barrel ?
6. If there are 34 lb. in a bushel of oats, what will be the weight of a load of oats consisting of 25 bags each containing 2 bushels ?
7. If 3 lb. of tea is divided into half-ounce packages, how many packages will there be ?
8. A barrel of flour weighs 196 lb. How many loaves of bread can be made from 3 barrels of flour if each loaf requires 14 oz. of flour ?

9. What part of a hundredweight is 50 lb.? 25 lb.? 60 lb.? $33\frac{1}{3}$ lb.?

10. What part of a ton is 300 lb.? 800 lb.? 1500 lb.? 750 lb.?

11. One-fourth of a ton is how many pounds? $\frac{3}{8}$ of a ton? $\frac{5}{8}$ of a ton?

Exercise 6

Reduce (change):

1. 3 lb. 2 oz. to ounces.
2. 5 lb. 7 oz. to ounces.
3. 15 lb. 16 oz. to ounces.
4. 200 oz. to pounds, etc.
5. 240 oz. to pounds, etc.
6. 1000 oz. to pounds, etc. (How can one get this result from question 4?)
7. 2 cwt. to pounds.
8. 3 cwt. 5 lb. to pounds.
9. 10 cwt. 20 lb. to pounds.
10. 20 cwt. 30 lb. 10 oz. to ounces.
11. 24 cwt. 35 lb. 12 oz. to ounces.
12. 2 T. to pounds.
13. 3 T. 5 cwt. to hundredweights.
14. 5 T. 6 cwt. to pounds.
15. 7 T. 9 cwt. 5 lb. to ounces.
16. 24 T. 10 cwt. 10 lb. 12 oz. to ounces.
17. 60 cwt. to tons.
18. 85 cwt. to tons, hundredweights.
19. 4005 cwt. to tons, hundredweights.
20. 8000 lb. to tons.
21. 10,400 lb. to tons, hundredweights.
22. 7500 lb. to tons, hundredweights.
23. 12,425 lb. to tons, hundredweights, pounds.
24. 80,000 oz. to tons.

Exercise 7

Add:

1.

lb.	oz.
3	4
7	9
12	12
18	3

2.

lb.	oz.
6	10
9	3
18	14
13	12

3.

lb.	oz.
17	6
25	12
16	5
8	2

4.

cwt.	lb.	oz.
2	3	2
8	74	10
12	47	13

5.

cwt.	lb.	oz.
9	9	8
5	16	7
14	87	4

6.

cwt.	lb.	oz.
4	24	2
7	33	15
9	45	10

7.

T.	cwt.	lb.	oz.
3	14	13	12
6	12	37	13
8	15	97	3
4	10	32	10

8.

T.	cwt.	lb.	oz.
7	3	25	2
8	6	50	4
10	9	75	6
15	12	85	8

Subtract:

9.

lb.	oz.
3	4
2	7

10.

lb.	oz.
13	9
12	12

11.

lb.	oz.
15	10
7	15

12.

cwt.	lb.	oz.
4	27	13
2	36	8

13.

cwt.	lb.	oz.
8	30	2
2	75	8

14.

cwt.	lb.	oz.
12	3	4
8	9	15

15.

T.	cwt.	lb.	oz.
13	14	23	5
6	15	25	8

16.

T.	cwt.	lb.	oz.
14	13	70	10
8	25	38	14

Multiply :

17.

lb.	oz.
4	3
<hr/>	
	5

18.

lb.	oz.
6	5
<hr/>	
	6

19.

lb.	oz.
19	12
<hr/>	
	8

20.

cwt.	lb.	oz.
3	60	5
<hr/>		
		9

21.

cwt.	lb.	oz.
9	80	12
<hr/>		
		10

22.

cwt.	lb.	oz.
15	45	13
<hr/>		
		15

23.

T.	cwt.	lb.	oz.
12	10	26	10
<hr/>			
			7

24.

T.	cwt.	lb.	oz.
14	12	38	12
<hr/>			
			12

25.

T.	cwt.	oz.
17	3	15
<hr/>		
		20

Divide :

26. 4 lb. 10 oz. by 2. 28. 4 cwt. 35 lb. 9 oz. by 3.
 27. 15 lb. 12 oz. by 12. 29. 7 T. 15 cwt. 8 lb. 2 oz. by 6.

Exercise 8

1. If a basket of coal weighs 80 lb., how many baskets will there be in a ton?
2. A cubic foot of hard coal weighs 90 lb. How many lb. can be put in a bin 12 ft. long, 6 ft. wide, and 4 ft. deep?
3. How much will 1750 lb. of hay cost at 75 ct. per cwt.?
4. A coal dealer bought coal at \$8.50 per ton and sold it at 70 ct. per cwt. Find his gain on the sale of 17 tons, 10 cwt.
5. A cow weighs 840 lb. She can be sold live weight for \$45, or she can be killed and sold at 12 ct. per lb. In the latter case $\frac{1}{4}$ of the weight will be lost. Which is the more profitable plan?

6. Find the value of :

- (a) 680 lb. of oats at 25 ct. a bushel.
- (b) 900 lb. of peas at 55 ct. a bushel.
- (c) 9648 lb. of barley at 40 ct. a bushel.

NOTE. — See Appendix A.

7. A farmer brought to the elevator 10 loads of wheat each containing 67 bushels. Each load weighed 4000 lb. How much did the whole weigh per bushel? What did the farmer get for his grain at 75 ct. per bushel (cleaned), provided 2 lb. were taken out of every 100 lb. in the cleaning?

8. A bushel of wheat produces 40 lb. of flour, which is sold at \$2.80 per cwt. How much wheat must the miller buy to sell sufficient flour to bring \$7168?

9. If the bran, etc. (question 8), brought him 90 ct. per cwt. and the wheat cost him 70 ct. per bushel, find his gain, his other expenses being \$350.

10. Bought 6600 lb. of wheat at 68 ct. a bushel; 6834 lb. of oats at 24 ct. a bushel; 9600 lb. of peas at 65 ct. a bushel, and 2400 lb. of barley at 45 ct. a bushel. I sold the whole at an average price of 1 ct. a pound. Find my gain or loss.

11. How many bushels :

(a) Of wheat at 65 ct. per bushel will pay for a binder costing \$130?

(b) Of oats at 40 ct. per bushel will pay for a wagon worth \$96?

(c) Of barley worth 54 ct. per bushel will pay the following grocery bill?

18 lb. tea at 65 ct.	15 lb. bacon at 15 ct.
17 lb. coffee at 43 ct.	20 lb. cheese at 12 ct.
23 lb. butter at 24 ct.	32 lb. sugar at 6 ct.
16 lb. rice at 8 ct.	7 lb. corn starch at 8 ct.

12. In an elevator there are stored 4,134,000 lb. of wheat. How many cars will this fill at 260 bushels to the car?

13. A farmer reaped 175 acres of wheat, 87 acres of barley, and 58 acres of oats. The wheat yielded 22 bushels per acre, the barley 19 bushels, and the oats 65 bushels. His expenses amounted to \$1265. Find the profit, the wheat being sold at 72 ct., the barley at 44 ct., and the oats at 28 ct. per bushel.

14. Find the value of:

(a) 3 lb. 4 oz. of cheese at 12 ct. per lb.

(b) 9 lb. 12 oz. of lard at 16 ct. per lb.

(c) 5 cwt. 75 lb. of flour at \$2.40 per cwt.

(d) 8 tons 12 cwt. 40 lb. of coal at \$10 per ton.

15. 49 lb. 12 oz. of candies are placed in boxes, each containing 3 lb. 5 oz. How many boxes are required?

16. A grocer mixed rice at 8 ct. a pound with an equal quantity worth 10 ct. a pound and sold the whole at 12 ct. a pound. He sold a customer \$8.40 worth. Find his gain. How many pounds were sold?

17. If a horse can draw 1700 lb. on a given road, how many men, each weighing 175 lb. 12 oz., can a team of horses draw on the same road?

18. Three persons together buy a quantity of butter weighing with the tub 267 lb. The first takes one cwt., the second 90 lb., and the third the remainder. Find what each had to pay, provided the tub weighed 7 lb. and the butter was worth 25 ct. a lb.

19. A grocer bought 6 cwt. of sugar for \$57; he used 60 lb., and sold the remainder so as to make \$2.40 profit on the whole quantity. How much per lb. did he get?



Exercise 9

DRY MEASURE

LIQUID MEASURE

2 pints (pt.) = 1 quart (qt.). 4 gills (gi.) = 1 pint.
 8 quarts = 1 peck (pk.). 2 pints = 1 quart.
 4 pecks = 1 bushel (bu.). 4 quarts = 1 gallon.

NOTE.— $31\frac{1}{2}$ gallons make 1 barrel. A hogshead is 63 gallons.

1. How many pints in 1 bu.? How many quarts?
How many gallons?
2. How many pints in 1 gal.? How many in 1 pk.?
3. How many quarts in 1 pk.?
4. If $\frac{3}{4}$ of a gal. of milk sells for 12 ct., find the selling price of 2 gal. milk.
5. If $\frac{3}{4}$ of the cost of a bushel of nuts is \$2.40, find the value of one pint of nuts; one quart.
6. What is $12\frac{1}{2}$ bu. of oats worth at 30 ct. a bu.?
7. Reduce to pints:
 - (a) 3 gal. 1 qt. 1 pt.
 - (b) 8 gal. 2 qt.
 - (c) 13 gal. 2 qt. 1 pt.

8. Reduce to gal., qt., pt. :

(a) 160 qt.

(c) 63 qt.

(b) 89 pt.

(d) 1422 pt.

9. What part of a gallon is 1 pt. ? 3 qt. ? 1 qt. ?

10. What part of a bushel is 16 pt. ? 12 gal. ? 16 qt. ?

11. A person sold 4 gal. 2 qt. maple syrup on Monday, 2 gal. 2 qt. on Tuesday, and 5 gal. 3 qt. on Wednesday. How much did he sell in the three days ? At a dollar a gallon what was it worth ?

12. A farmer sowed 1 bu. 4 qt. of timothy seed and 1 bu. 2 pk. 3 qt. of brome grass. How much did he sow of both ?

13. A man had 7 bu. 3 pk. of potatoes ; he sold 15 pk. How much had he left ?

14. A horse eats 2 pk. 6 qt. of oats in 3 days. How much will last him 15 days ?

15. When wheat is worth \$1.60 a bushel, what will 12 quarts cost ?

16. What is the value of a load of oats weighing 1037 pounds at 10 cents a peck ?

17. A market woman sold 14 lb. 12 oz. of butter at 32 cents a pound, and with the proceeds bought molasses at \$1.18 a gallon. How many gallons did she buy ?

18. A farmer traded 20 bu. of wheat at \$1.20 per bushel for 40 bu. of oats and \$6 cash. How much was a bushel of oats worth ?

Exercise 10

1. Add :

(a) 3 gal. 2 qt. 1 pt. and 4 gal. 3 qt. 5 pt.

(b) 6 pk. 2 qt. 3 pt. and 5 pk. 3 qt. 6 pt.

(c) 3 qt. 1 pt. 1 gi. and 4 qt. 3 pt. 2 gi.

(d) 3 bu. 2 pk. 3 qt. 2 pt. and 5 bu. 4 pk. 5 qt. 8 pt.

2. Find the cost of :

- (a) 3 gal. 2 qt. of milk at 6 ct. a quart.
- (b) 7 gal. 3 qt. 4 pt. of maple syrup at 60 ct. a pint.
- (c) 4 bu. 3 pk. of potatoes at 40 ct. a bushel.
- (d) 3 pk. 6 qt. 1 pk. of berries at 12 ct. a quart.

3. Find the difference between :

- (a) 19 gal. 1 pt. and 8 gal. 3 qt.
- (b) 80 bu. and 36 bu. 3 pk. 7 qt.
- (c) 27 bu. 1 pk. 5 qt. and 13 bu. 3 pk. 7 qt.
- (d) 100 gal. 1 qt. and 75 gal. 2 qt. 1 pt.

4. A man had 9 bu. 3 pk. of currants ; he sold 5 bu. 6 pk. How much was left ? What was the remainder worth at 15 ct. a pint ?

5. From a bin containing 15 bu. 3 pk. 2 qt. of oats 9 bu. 3 pk. and 5 qt. were taken. How much was left ?

6. If 3 gal. 2 qt. 1 pt. of milk are taken from a can containing 10 gal., how much is left in the can ?

7. A farmer sold out of 5 bu. of wheat the following quantities : 3 pk. 6 qt. ; 4 pk. ; 3 pk. 3 qt. ; 1 bu. 1 pk. 1 qt. How much has he still left ?

8. On Monday a boarding-house used 4 gal. 2 qt. of milk ; on Tuesday, 5 gal. ; on Wednesday, 5 gal. 1 qt. 1 pt. ; on Thursday, 6 gal. 3 qt. ; on Friday, 7 gal. 5 pt. ; on Saturday, 3 gal. 2 qt. 1 pt. ; and on Sunday, 2 gal. 1 pt. What was the milk bill for the week at 14 quart tickets for a dollar ?

9. Multiply :

- (a) 9 gal. 3 qt. by 2.
- (b) 12 gal. 3 qt. 1 pt. by 3.
- (c) 16 bu. 3 pk. 4 qt. by 5.
- (d) 24 bu. 2 pk. 3 qt. 2 pt. by 8.
- (e) 3 pk. 13 qt. by 12.

10. A grocer sold 3 gal. 2 qt. 1 pt. of molasses to each of 6 customers. What did he receive if molasses sells for 70 ct. a quart?

11. From a cask containing 16 gal. 2 qt. of vinegar, enough vinegar was taken to fill four bottles, each holding 2 gal. 1 qt. 1 pt. How much was left in the cask?

12. Divide:

(a) 19 gal. 3 qt. 1 pt. by 3.

(b) 32 bu. 3 pk. 3 qt. 1 pt. by 4.

(c) 7 gal. 3 qt. 4 pt. by 8.

(d) 14 qt. 5 pt. by 5.

13. How many boxes containing:

(a) 3 qt. 2 pt. can I fill from 80 qt. of berries?

(b) 1 gal. 2 qt. 1 pt. can I fill from 5 bu. 2 qt. 1 pt. of wheat?

(c) 3 bu. 1 pk. 2 qt. 1 pt. can I fill from 68 bu. 1 pk. 3 qt. 1 pt. of barley?

14. If I feed my chickens 1 quart 1 pint of wheat per day, how long will a 2-bushel bag of wheat last me?

15. Reduce:

(a) 35 gal. to pints.

(b) 4 bu. 2 pk. to pecks.

(c) 18 gal. 2 qt. to pints.

(d) 16 bu. 2 pk. to quarts.

(e) 456 pt. to gallons.

(f) 1280 qt. to gallons.

Exercise 11

1. A man bought a bushel of nuts. After he had sold 2 pk. 4 qt. of nuts, how much is the remainder worth at 6 ct. per pint?

2. A milk dealer puts 30 gallons of milk in cans holding 1 qt. 1 pt. each. How many cans does he fill?

3. What part of a bushel is 1 gallon 3 quarts and 2 pints?

4. Make up the amount of the following bill:

7 qt. 1 pt. of syrup at 50 ct. a pint.

2 bu. 3 pk. potatoes at 96 ct. a bushel.

3 gal. 1 pt. of vinegar at 24 ct. a quart.

5. Add: 8 bu. 2 pk. 4 qt. 19 bu. 3 pk. 7 qt.

5 bu. 3 pk. 3 qt. 10 bu. 2 pk. 5 qt.

2 bu. 1 pk. 5 qt. 6 bu. 3 qt.

6. If $\frac{2}{3}$ of a bushel of wheat costs 48 ct., find the price of 17 bu. 3 pk. of wheat.

7. A lamp will use a quart of coal oil in 5 days. If coal oil is worth 32 ct. a gallon, find what my coal-oil bill will be in a year.

8. If 6 chickens eat 3 quarts of grain in 3 days, and grain is worth 64 ct. a bushel, find how much my chicken food will cost me for the month of November.

9. John Smith had 160 acres of wheat. It yielded 23 bu. 3 pk. per acre. He sold it at 80 ct. per bushel; what did he receive?

10. I bought a horse for \$120. During the 6 weeks he was in my possession I fed him 2 gal. 3 qt. 1 pt. of oats daily. I hired him out for 5 out of the 6 weeks at the rate of \$2.40 per day. What did I sell him at to gain \$50, oats being worth 32 ct. a bushel?

11. What will be the cost of 3 bu. 2 pk. 7 qt. 1 pt. of oats if 7 bu. 1 qt. cost \$4.50?

12. A cask of molasses contained 80 gallons. One-fourth of it leaked out. If the molasses cost 90 ct. per gallon, how much per gallon should I get for the remainder so that there will be no loss?

Exercise 12 (Oral)

1. How many:

- (a) Pints in $\frac{1}{2}$ a quart? (c) Quarts in a bushel?
 (b) Pints in $\frac{1}{2}$ a gallon? (d) Quarts in a peck?

2. If 1 qt. of syrup costs 24 ct., what will a gallon cost?
 3 gal.? 7 gal.?

3. One pint of milk costs 4 ct.; what will 4 quarts cost?
 2 gallons? $3\frac{3}{4}$ gallons?

4. At 12 ct. a quart, how many quarts of fruit can be bought for \$1.20? \$3.56? \$3.84?

5. If $\frac{1}{2}$ a gallon of maple syrup costs 64 ct., what will 3 pints cost? 3 gills? 7 quarts?

6. At 30 ct. a quart, how many gallons of molasses can be bought for \$3.60? \$6? \$8.40? \$10.80?

7. If I can pick 20 quarts of raspberries in 1 day, how many baskets each holding $\frac{1}{4}$ of a bushel can I fill from the berry picking of 6 days?

8. At 75 ct. a bushel, how much wheat can be sold for \$75? \$15? \$36?

9. How many ounces in: How many pounds in:

- | | |
|--------------------------|-------------|
| (a) 3 lb.? | (a) 64 oz.? |
| (b) $4\frac{1}{2}$ lb.? | (b) 72 oz.? |
| (c) $8\frac{3}{4}$ lb.? | (c) 40 oz.? |
| (d) $10\frac{3}{4}$ lb.? | (d) 12 oz.? |

TIME MEASURE

60 seconds (sec.)	= 1 minute (min.).
60 minutes	= 1 hour (hr.).
24 hours	= 1 day (da.).
7 days	= 1 week (wk.).
4 weeks	= 1 month (nearly).
12 months	= 1 year (yr.).
365 days	= 1 common year.
366 days	= 1 leap year.
100 years	= 1 century.

NOTE.—A.M. means *before noon*. P.M. means *after noon*. M. means *noon*. Any year like 1200, 1800, 2000 if exactly divisible by 400 is a leap year. Other years exactly divisible by 4 are leap years.

Exercise 13

1. What part of a minute is 30 seconds? 20 seconds? 45 seconds? 10 seconds? 12 seconds?
2. How many seconds in $\frac{1}{2}$ a minute? $\frac{3}{4}$ of a minute? $\frac{1}{5}$ of a minute? $\frac{2}{3}$ of a minute?
3. What part of an hour is 30 minutes? 40 minutes? 50 minutes? 18 minutes? 45 minutes?
4. How many minutes in $\frac{3}{4}$ of an hour? $\frac{2}{3}$ of an hour? $\frac{5}{6}$ of an hour? a quarter of an hour?
5. What part of a day is 12 hours? 6 hours? 18 hours? 20 hours? 15 hours?
6. How many hours in $\frac{2}{3}$ of a day? $\frac{1}{6}$ of a day? $\frac{3}{4}$ of a day?
7. Which is the first day of the week? The central day? The last day? How many school days are there in $2\frac{3}{4}$ weeks? How many working days are there in a week?

8. How many days in each of the months of winter? autumn? spring? How many days in the summer season?

9. What day in spring has 12 hours' sunlight? What day in autumn has 12 hours' sunlight? How many days between these dates?

10. What part of a year is 8 months? 9 months? 6 months? 4 months? 10 months?

11. How many months in $\frac{1}{2}$ a year? in $\frac{2}{3}$ of a year? in $\frac{3}{4}$ of a year?

12. What century are we living in? When did it begin? On what day will it end?

13. What part of a century is 75 years? 40 years? $33\frac{1}{3}$ years? $66\frac{2}{3}$ years? 25 years?

14. How many years in $\frac{7}{10}$ of a century? $\frac{3}{4}$ of a century? $\frac{2}{5}$ of a century?

15. Make a list of the *common* and *leap* years in the following: 1896, 1900, 1903, 1906, 1960, 2400, and 2764.

(a) If June comes in on Friday, what will be the name of June 30th?

(b) If September comes in on Wednesday, what are the Monday dates?

Exercise 14

1. How many hours from 4 o'clock Sunday P.M. to 10 o'clock Wednesday A.M.?

2. How many days from May 3d to June 15th? from August 1st to February 10th? from March 18th to November 21st?

3. A boy began a work on the morning of October 3d and finished on the evening of January 3d. How much did he earn at \$1.75 per working day?

4. How many days from :

(a) February 14th, 1904, to January 18th, 1905?

(b) January 21st, 1900, to March 12th, 1904?

(c) September 28th, 1896, to November 23d, 1898?

NOTE. — In finding the time between dates, exclude either the first or the last day. From the 3d to the 27th is considered 24 days.

5. How many days does a vacation last if it begins on :

(a) The 24th day of December and ends on the 3d day of January?

(b) Dominion Day and ends on the 18th of August?

6. A man borrowed some money on April 18th. He agreed to return it in 4 months and 3 days. On what day should the money be returned?

7. A traveller set out from Montreal on April 27th to reach Fort Good Hope on the Mackenzie River. If he reached the fort on the last day of June, how many days did he spend on the journey?

8. How many minutes in 1 hr. and 45 min.? in $2\frac{1}{2}$ hours? in $5\frac{2}{3}$ hours?

9. How many seconds in $1\frac{3}{4}$ minutes? in $4\frac{2}{3}$ minutes? in 1 hour? in $1\frac{1}{2}$ hours? in 1 hour 20 minutes?

10. How many days and hours in :

(a) 2000 hours?

(c) 6000 minutes?

(b) 869 hours?

(d) 216,000 seconds?

11. How many hours does a man work in a year if he works from 7 A.M. to 6 P.M. each working day, and also takes a vacation of two weeks?

12. If a train runs at the rate of 30 miles an hour, how long will it take to run 165 miles, provided it makes five stops of 7 minutes each on the way?

13. How many months and days from :

- (a) June 2d to September 5th?
- (b) September 10th to February 18th?
- (c) Christmas Day to St. Valentine's Day?
- (d) From Empire Day to All Saints' Day?

14. A horse dealer bought a herd of 60 horses on June 7th at the rate of \$95 a head. The seller agreed to feed the horses for him from the date of purchase until the 18th of the month, at the rate of 17 ct. a head per day. On the 18th the buyer sold the herd at \$115 a head. Find his gain.

15. The first day of January, 1905, is Sunday. On what day of the week is :

- (a) Christmas?
- (c) All Fools' Day?
- (b) July 1st?
- (d) May 24th?

• Exercise 15

1. How many minutes in 800 seconds? 300 seconds? 730 seconds? 2000 seconds?

2. How many seconds are there in 23 min. 10 sec.? 35 min. 18 sec.? 45 min. 25 sec.?

3. How many minutes are there in 6 hours? 9 hours? 10 hr. 13 min.? 20 hr. 35 min.?

4. How many hours are there in 720 minutes? In 900 minutes? In 3000 minutes?

5. How many seconds in 3 hours? In 2 hr. 10 min.? In 3 hr. 45 min. 20 sec.?

6. How many days in 280 hours? In 300 hours? In 1440 minutes?

7. How many weeks in 72 days? 1000 days? In 912 hours? In 20,160 minutes? In 2,024,400 seconds?

8. How many years in 104 weeks? In 800 weeks? In 730 days? In 2800 days? In 17,520 hours?

9. Find the exact date from February 6th:

(a) Three months back.

(b) Four months eleven day back.

(c) Two years and two months back.

10. At what age did a person die who was born June 3d 1837, and died December 5th, 1904?

11. A man travelled at the rate of $4\frac{1}{2}$ miles an hour for 8 hours, and then returned at the rate of $3\frac{1}{2}$ miles an hour. How long was it from the time of his setting out to his return?

12. On a river which flows at the rate of 3 miles an hour a man, who can paddle 7 miles an hour in still water, paddles down the river for 6 hours. How far is he then from his starting-point? How long will it take him to paddle back?

13. A man bought a cow for \$45. He paid 35 ct. a day for hay and oats to feed her, and sold each day's milk at the rate of 12 ct. a quart. After keeping the cow for a fortnight he sold her for \$48. How much did he make, provided she gave 5 quarts 1 pint of milk morning and evening?

14. On what day of the month will a boy reach his journey's end, if he has 900 miles to ride upon a bicycle and sets out on Saturday, May 24th, riding 6 days in a week, 8 hours a day, and 6 miles an hour?

15. A train leaves Truro at noon at the rate of 30 miles an hour. Another train follows at half-past 2 P.M. at 40 miles an hour. When will the fast train overtake the slow train? how far from Truro?

16. How much an hour do I pay a laborer who works $5\frac{1}{2}$ days, 8 hours a day, and receives \$6.60 for his time?

17. Harry walks at the rate of 6600 paces an hour and reaches home in 45 minutes. How many paces did he take? What distance did he go, provided each pace is 2 feet 8 inches?

18.

TIME SHEET

MEN	MON.	TUES.	WED.	THUR.	FRI.	SAT.	WAGES PER	WEEK'S
							HR. WORK	EARNINGS
John Smith	9	9½	8	10	9½	8		
Thomas Jones	8½	9	7½	9	8½	7½		
James Black	10	9½	8½	7½	10	9½		
Alfred Main	8	9	10	8	9	10		
Henry Moore	7½	8½	0	7½	8½	0		
Robert Young	6	7½	10	8½	9	7		

The foregoing is the weekly time sheet of a certain factory.
Find:

- (a) The total week's wages of the six men.
- (b) How much money Henry Moore lost by being absent Wednesday and Saturday (10 hours a full day).
- (c) How much more Alfred Main earned than Robert Young; than Henry Moore.
- (d) How many full days' work at 10 hours a day is equal to the whole time of the six men.

LINEAR MEASURE

12 inches	= 1 foot (ft.).
3 feet	= 1 yard (yd.).
5½ yards, or 16½ feet,	= 1 rod (rd.).
320 rods, 1760 yards, or 5280 feet	= 1 mile (mi.).
22 yards, or 66 feet,	= 1 chain (ch.).
80 chains	= 1 mile.
100 links	= 1 chain.

NOTE. — The *footrule*, *yardstick*, and *rod* should be in the schoolroom for the use of the pupils.

Exercise 16

1. How many inches in $\frac{3}{4}$ of a foot? $\frac{3}{4}$ of a foot? $\frac{1}{2}$ of a foot? 2 feet? $3\frac{1}{2}$ feet? 10 feet?

2. What part of a foot is 9 inches? 8 inches? 4 inches? 15 inches? 20 inches?

3. What part of a yard is 18 inches? 12 inches? 30 inches? 27 inches? 2 feet? 2 feet 3 inches? 9 inches?

4. Make a rod measure using a cord. With it measure:

(a) The distance across the street.

(b) The distance from the school gate to the back of the grounds.

(c) The distance from the school door to the farthest corner of the grounds.

(d) The distance across a quarter-section.

SUGGESTION. — Two boys may do this for the class after school.

5. How many steps do you have to take to walk 8 rods? With this knowledge step off:

(a) 3 rods.

(b) 5 rods.

(c) 10 rods.

6. How long does it take you to walk to school? How far away from the schoolhouse is your home? At what rate do you walk? How long does it take you to walk a mile?

7. Draw, without using a rule, a line one rod long on the blackboard.

8. How many inches in 2 yards? 3 yards? 7 yards? 10 yards?

9. How many feet are there in 2 yards? 5 yards? 6 yards 2 feet?

10. How many feet in a rod? In 2 rods? In 6 rods? In a mile? In $\frac{1}{2}$ a mile? In $\frac{3}{4}$ of a mile? In $\frac{3}{8}$ of a mile?

11. How many yards in 2 rods? In 6 rods? In a mile? In $\frac{3}{4}$ of a mile? In $\frac{1}{8}$ of a mile?

12. What part of a mile is 880 yards? 1760 feet? 160 rods? 40 rods? 80 rods? 60 chains?

13. What part of a chain is 60 links? 75 links? 10 links? 50 links?

14. How many chains in 3 miles? In $\frac{1}{2}$ a mile? In $\frac{3}{4}$ of a mile?

15. If $\frac{2}{3}$ of a yard of cloth costs 18 cents, how much will a piece of the same cloth measuring 24 feet cost?

16. How many pieces of string $\frac{2}{3}$ of a yard long can be cut from a piece 8 yards long?

17. A lot is 6 rods wide and 10 rods long. How often will one have to walk around this lot to walk 3 miles? 7 miles? $9\frac{1}{2}$ miles? 5280 yards?

18. How many minutes will it take to walk 2 miles, at the rate of 16 rods a minute?

19. If the distance around a wheel is 12 feet, how many times will the wheel turn around in going a mile?

20. Add:

(a) 3 yd. 2 ft. 9 in. and 7 yd. 1 ft. 8 in.

(b) 16 yd. 3 ft. 14 in. and 18 yd. 9 ft. 12 in.

21. Find the difference between:

(a) 23 yd. 2 ft. 10 in. and 17 yd. 1 ft. 11 in.

(b) 31 yd. 4 ft. 5 in. and 23 yd. 5 ft. 8 in.

22. A merchant bought four pieces of cloth containing 15 yd. 2 ft. 3 in., 16 yd. 1 ft. 9 in., 12 yd. 14 in., and 20 yd. 10 in. If the cloth cost \$3.60 per yard, what had the merchant to pay?

23. From a piece of cloth containing 40 yd. 2 ft., a piece containing 19 yd. 1 ft. 6 in. has been sold. What was the remainder worth at 72 cents a yard?

24. A field is a mile long and $\frac{1}{2}$ a mile wide. How many fence boards 12 feet long will it take to reach around this field? How many of such boards will it take to build a fence 3 boards high around this field?

Exercise 17

1. Add:

(a)	(b)
3 mi. 16 rd. 4 yd. 2 ft. 3 in.	4 rd. 2 yd. 1 ft. 5 in.
7 mi. 8 rd. 5 yd. 1 ft. 8 in.	6 rd. 3 yd. 2 ft. 6 in.
6 mi. 3 rd. 2 yd. 2 ft. 1 in.	7 rd. 4 yd. 1 ft. 11 in.
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2. Subtract:

(a)	(b)
8 mi. 13 rd. 3 yd. 2 ft. 3 in.	7 rd. 3 yd. 1 ft. 3 in.
5 mi. 15 rd. 4 yd. 2 ft. 5 in.	4 rd. 4 yd. 2 ft. 7 in.
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3. Multiply:

- (a) 2 miles 15 rods 4 yards 2 feet 7 inches by 6.
 (b) 5 miles 18 rods 2 yards 1 foot 8 inches by 8.

4. Divide:

- (a) 6 miles 12 rods 3 yards 1 foot 4 inches by 5.
 (b) 7 miles 18 rods 2 yards 2 feet 8 inches by 4.

5. Reduce:

- (a) 3 miles 30 rods to rods.
 (b) 2 miles 20 rods to yards.
 (c) 16 rods 3 yards to feet.
 (d) 14 yards 2 feet 5 inches to inches.

6. Reduce:

- (a) 648 rods to miles and rods.
- (b) 165 chains to miles and chains.
- (c) 320 chains to rods.
- (d) 160 rods to chains.

7. How many cents could be placed in a row round the edge of a table 6 feet long by 5 feet wide?

8. A horse stands 18 hands 3 inches high. How high is this, a hand being equal to 4 inches?

9. The lake at a certain point is said to be 30 fathoms in depth. How deep is this, a fathom being 6 feet?

10. A lot is 4 chains wide and 10 chains long. How many yards around the lot? How many rods? How many feet?

11. Harry can take 150 steps, $2\frac{1}{2}$ feet long, per minute. How long would it take him to walk 7500 yards?

12. If a contractor builds a sewer or drain for \$2.40 a foot, and the materials and labor cost him \$1.45 a yard, how much will he make in building a sewer 32 rods 4 yards in length?

13. If two men set out from the same place at the same time and travel in opposite directions, one at the rate of $4\frac{1}{2}$ miles an hour and the other $3\frac{3}{4}$ miles an hour, how far will they be apart in 6 days, provided they walk 12 hours a day?

14. A man can dig 8 rods 4 yards of a ditch in a day. In how many days can he dig a ditch a mile long all but 32 yards? What is this worth at 5 cents a foot?

15. Find the distance around the following grass plots, each of which is bordered by a walk:

- (a) Outside measurements of the lot, 40 feet by 30 feet; width of walk, 3 feet.

(b) Outside measurements of the lot, 75 feet by 60 feet ; width of walk, 5 feet.

(c) Outside measurements of the lot, 100 feet by 75 feet ; width of walk, 6 feet.

16. Find the distance around the outside of the following lots, each of which consists of a grass plot, surrounded by a walk :

(a) Length of grass plot, 48 feet ; width, 30 feet ; width of walk, 4 feet.

(b) Length of grass plot, 60 feet ; width, 45 feet ; width of walk, 8 feet.

(c) Length of grass plot, 70 feet ; width, 50 feet ; width of walk, 6 feet.

17. If cloth $\frac{2}{3}$ of a yard wide costs 80 cents a yard, what should the same kind of cloth $\frac{1}{2}$ a yard wide cost ?

18. A farmer ploughs a furrow 6 inches wide and half a mile long. How far will he walk in ploughing a width of 45 yards, no allowance being made at the turnings ?

19. If telegraph posts are placed 80 yards apart, and a train passes one every 4 seconds, how many miles an hour is it running ?

Exercise 18

SURFACE MEASURE

144 square inches (sq. in.)	= 1 square foot (sq. ft.).
9 square feet	= 1 square yard (sq. yd.).
30 $\frac{1}{4}$ square yards	= 1 square rod (sq. rd.).
4840 sq. yd. or 160 sq. rd. (10 sq. chains)	= 1 acre (A.).
640 acres	= 1 square mile (sq. mi.).
1 square mile, or 640 acres	= 1 section of land.
36 sections	= 1 township.

1. What is a square inch? A square foot? A square yard? A square mile? A square rod?
2. What is the distance around a square inch? A square yard? A square mile? A square rod?
3. How large a surface does an inch square enclose? A yard square? A rod square? A chain square?
4. Draw on the blackboard a square foot and divide it into inch squares. How many inch squares are there?
5. Draw on the blackboard a square yard and divide it into square feet. How many square feet are there?
6. Show by a diagram drawn upon your exercise book on a scale of $\frac{1}{2}$ an inch to a yard that a square rod consists of $30\frac{1}{4}$ square yards. How many square feet in a square rod?
7. What name do you give all plane surfaces bounded by four straight lines and having four right angles?
8. Show by a drawing that a piece of board 9 inches long and 5 inches wide contains 45 square inches.
9. Find by measuring:
 - (a) The number of square inches on this page.
 - (b) The number of square inches on the surface of your desk.
 - (c) The number of square feet on the schoolroom floor.
 - (d) The number of square feet in all the window panes in the room.
10. How many square feet in:
 - (a) A board 2 ft. wide and 13 ft. long?
 - (b) A platform 8 ft. long and 5 ft. wide?
 - (c) A room 18 ft. long and 15 ft. wide?

11. What will it cost to paint :
- (a) A floor 18 ft. by 12 ft. at 3 ct. a square foot?
 - (b) A floor 24 ft. by 15 ft. at 15 ct. a square yard?
 - (c) A fence 100 ft. by 6 ft. at 10 ct. a foot length?
12. How many square yards of surface in :
- (a) A floor 20 by 18 feet?
 - (b) A door 9 by 6 feet?
 - (c) A lot 90 by 70 feet?

Exercise 19

1. What part of one square foot is one square inch?
What part of one square inch is one square foot?
2. 36 square inches is what part of a square foot? 108 square inches is what part of a square foot?
3. What part of one square yard is one square foot?
4. How many square inches are there in a 3-inch square?
A 5-inch square? A 10-inch square?
5. How does a 2-inch square compare with a 3-inch square? A 5-inch square with a 6-inch square?
6. What is the difference between a 6-inch square and 6 square inches? A 10-inch square and 10 square inches?
An 8-yard square and 8 square yards?
7. How many square rods in an acre? What is the shape of an acre of land?
8. How many square rods in 3 acres? 5 acres? 10 acres?
 $9\frac{1}{2}$ acres? $\frac{1}{2}$ an acre? $\frac{3}{4}$ an acre?
9. How many square rods are there in :
- (a) A rectangle 10 rods by 6 rods?
 - (b) A rectangle 12 rods by $4\frac{1}{2}$ rods?

10. How many square feet in 8 square rods? 12 square rods?
11. How many square yards in 4 square rods? 6 square rods?
12. How many square yards in a plot :
 - (a) 6 rods by 4 rods?
 - (b) 10 rods by 8 rods?
13. How many square feet in a plot :
 - (a) 2 rods by 1 rod?
 - (b) 4 rods by 3 rods?
14. What is the value of a piece of ground :
 - (a) 8 rods by 7 rods at 15 cents a square yard?
 - (b) 5 rods by 4 rods at 10 cents a square foot?
15. Into how many house lots, each 8 rods long and 5 rods wide, can a field 40 rods by 30 rods be divided?
16. A tract of land has an area of one acre :
 - (a) Its length is 10 rods; find its width.
 - (b) Its width is 40 rods; find its length.
17. What part of an acre is a lot :
 - (a) 16 rods long by 5 rods wide?
 - (b) 8 rods long by 4 rods wide?
 - (c) 25 rods long by 4 rods wide?
18. How many acres in :
 - (a) A piece of land 80 rods by 16 rods?
 - (b) A piece of land 40 rods by 40 rods?
 - (c) A piece of land 96 rods by 10 rods?
 - (d) A piece of land 440 yards by 220 yards?

19. How many acres in:

- (a) A square a mile to a side?
- (b) A square $\frac{1}{2}$ a mile to a side?
- (c) A square $\frac{1}{4}$ of a mile to a side?
- (d) A square $\frac{1}{8}$ of a mile to a side?

20. A railway strip is 75 miles long and 8 rods wide. How many acres does it contain?

Exercise 20

1. An acre of town property was divided into lots 5 rods long by 4 rods wide. Find:

- (a) The number of lots.
- (b) The shape of the block of land divided.

2. From a farm of 80 acres two lots containing 8 acres 150 sq. rd., and 3 acres 90 sq. rd., were sold. Find the value of the remainder at \$20 per acre.

3. To my quarter-section I have added three other lots containing 10 acres 80 sq. rd., 24 acres 40 sq. rd., and 125 acres 40 sq. rd. How large a farm do I now own?

4. If a section of land were divided into 16 equal areas, what would be the acreage of each?

5. How many square miles in a strip of country:

- (a) 4 miles long by 3 miles wide?
- (b) 6 miles long by $3\frac{1}{2}$ miles wide?
- (c) 10 miles long by $2\frac{3}{8}$ miles wide?

6. How many acres in each of the strips described in question 5?

7. Sections of land in Manitoba and in the North-West Territories are grouped in squares similar to Figure A:

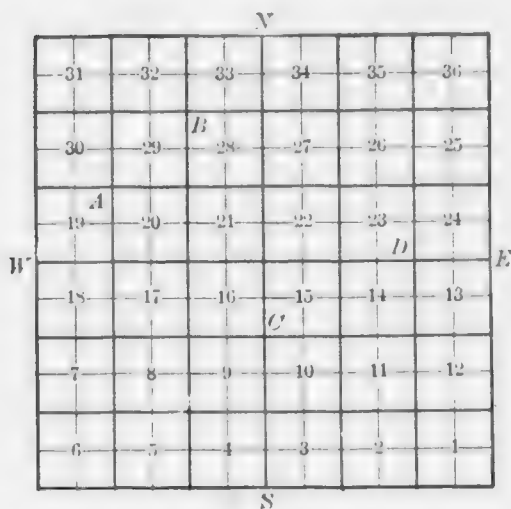


FIG. A

- (a) How many sections are there in a township?
 - (b) How many acres are there in a township?
 - (c) How many rods around a section?
 - (d) How many rods are there around a quarter-section?
 - (e) How many square rods in a quarter-section?
 - (f) Name the quarter-section marked *A*, *B*, *C*, and *D* in Figure A.
 - (g) How much would it cost to fence a quarter-section at 40 ct. a rod? A section at 40 ct. a rod? A township at 40 ct. a rod?
 - (h) If the distance round a quarter-section be represented by 1, what numbers will represent:
 - (a) The distance round a section?
 - (b) The distance round a township?
 - (i) How far is section 4 from section 21? From section 6?
8. A real estate dealer bought the following lands at \$3 an acre and sold them at \$7.50 an acre. How much did he

make? Sections 3, 7, and 9; the western halves of sections 4 and 10; and the north-east quarters of sections 23, 27, and 36.

9. Reduce:

- (a) 5 acres 3 sq. rd. to square rods.
- (b) 10 acres to square yards.
- (c) 12 acres 100 sq. rd. to square yards.

10. How many square yards in:

- (a) 16 sq. rods?
- (b) 20 sq. rods?

11. How many chains around:

- (a) A section of land?
- (b) A quarter-section of land?
- (c) A township?

12. Reduce:

- (a) 7 sq. yd. to square inches.
- (b) 15 sq. yd. 6 sq. ft. to square inches.

13. Reduce:

- (a) 960 square rods to acres.
- (b) 1820 square rods to acres.

14. Reduce:

- (a) 8 square chains to square yards.
- (b) 12 square chains to square feet.
- (c) 20 square chains to square rods.

15. How many square chains in an acre? Find the number of acres in a piece of land:

- (a) 40 chains by 30 chains.
- (b) 16 chains by 10 chains.

16. How many acres in a piece of land:

(a) 80 rods by 60 rods?

(b) 96 rods by 40 rods?

17. The road allowance between two sections of land is 99 feet. How many acres are there in 6 miles of such road allowance?

18. A quarter-section has been purchased at \$37 an acre. How much is gained by selling it at 75 ct. a square rod?

19. A strip of land 4 rods wide is fenced off from the whole side of a section. Find the area of the remainder.

Exercise 21

CUBIC, OR SOLID, MEASURE

1728 cubic inches = 1 cubic foot (cu. ft.).

27 cubic feet = 1 cubic yard (cu. yd.).

128 cubic feet = 1 cord.

1. What is an inch cube? A foot cube? A yard cube?

2. Show that a two-inch cube contains 8 cubic inches.

3. How many inch cubes are there in:

(a) A 5-inch cube? (c) A 10-inch cube?

(b) A 7-inch cube? (d) A 20-inch cube?

4. How many foot cubes are there in:

(a) A 36-inch cube?

(b) A 7-foot cube?

(c) A yard cube?

5. How many yard cubes are there in:

(a) A 10-yard cube?

(b) A 15-yard cube?

6. How many inch cubes can be placed on a table :
- (a) 24 inches by 30 inches ?
 - (b) 3 feet by 2 feet ?
 - (c) 2 yards by 1 yard 2 feet ?
7. How many foot cubes can be placed on a floor :
- (a) 24 ft. by 15 ft. ?
 - (b) 36 yds. by 18 yds. ?
8. How many inch cubes will cover exactly a square surface :
- (a) 6 inches long ?
 - (b) 12 inches long ?
 - (c) 18 inches long ?
9. How many similar layers would have to be added to each of the layers in question 8 to make a cube ?
10. Into how many 3-inch cubes can a 6-inch cube be divided ? A 9-inch cube ? A 15-inch cube ?
11. How many cubic feet of air are there in :
- (a) A room 20 ft. long, 16 ft. wide, and 9 ft. high ?
 - (b) A room 32 ft. long, 18 ft. wide, and 15 ft. high ?
 - (c) A room 6 yd. long, 4 yd. wide, and 6 yd. high ?
 - (d) A room 360 inches long, 180 inches wide, and 120 inches high ?
12. Reduce :
- (a) 5427 cubic feet to cubic yards.
 - (b) 13 cubic yards to cubic feet.
 - (c) 6 cubic yards 20 cubic feet to cubic inches.
 - (d) 93,312 cubic inches to cubic yards.

Exercise 22

1. What will it cost to dig a ditch:
 - (a) 200 yd. long, 6 ft. wide, and 3 ft. deep, at 35 ct. per cu. yd.?
 - (b) 180 yd. long, 4 ft. deep, and 8 ft. wide, at 40 ct. per 32 cu. ft.?
2. How many cubic feet will there be in:
 - (a) A wall 60 yd. long, 4 ft. thick, and 6 ft. high?
 - (b) A pile of brick 40 ft. long, 2 yd. wide, and 72 in. high?
 - (c) A cellar 24 ft. long, 18 ft. wide, and 6 ft. deep?
 - (d) A pile of wood 240 ft. long, 6 ft. high, and 4 ft. wide?
3. Find the outside measurement of a wall built around a rectangle:
 - (a) 24 ft. long, and 20 ft. wide, the wall being 3 ft. thick.
 - (b) 60 ft. long, and 48 ft. wide, the wall being 4 ft. thick.
 - (c) 72 ft. long, and 21 yd. wide, the wall being a yd. thick.
4. Find in square feet the surface of each of the tops of the walls described in question 3.
5. What are the dimensions of a cord of wood? Find the number of cords of wood in a pile:
 - (a) 64 ft. long, 8 ft. high, and 8 ft. wide.
 - (b) 256 ft. long, 6 ft. high.
 - (c) 72 yd. long, 3 yd. high, and 12 ft. wide.
6. From a pile of wood 168 ft. long, 12 ft. high, and 4 ft. wide, 20 loads each 12 ft. long, 4 ft. high were removed. How much wood was left?
7. A wood sawyer puts 3 cuts into each stick of wood. How long a pile 4 ft. high will he have when he completes the sawing and piling of a pile of wood 56 ft. long, 8 ft. high?

8. If a wood sawyer gets 80 ct. for cutting a cord of cordwood into two pieces, what should he get for cutting it into three pieces?

9. How many boxes 7 in. long, 4 in. wide, and 3 in. deep can be packed into a case 14 ft. long, 3 ft. wide, and 3 ft. deep? Into a case 7 ft. long, 2 ft. wide, and 9 in. deep?

10. How does a cube 9 in. long compare with a cube 3 ft. long? A cube a yard wide, with a cube a foot wide? A room 20 ft. long, 12 ft. wide, and 10 ft. high, with a room 40 ft. long, 36 ft. wide, and 20 ft. high?

Exercise 23

MEASURE OF NUMBER

12 units = 1 dozen.

20 units = 1 score

12 dozen = 1 gross.

24 sheets of paper = 1 quire.

20 quires = 1 ream.

1. How many sheets of paper in $\frac{1}{2}$ a quire? In a quire and a half? In $2\frac{3}{4}$ quires? In $5\frac{3}{4}$ quires?

2. If I should use 2 sheets of paper with each letter, how many letters could I write with a quire of paper? With $2\frac{3}{4}$ quires? With 6 quires? With a ream?

3. If I should use 3 sheets of paper for each envelope, how many envelopes would I require for a quire of letter paper? 3 quires? A ream? How many quires would it take for 96 envelopes?

4. A quire of paper costs 48 ct. How many sheets do I get for 12 ct.? For 16 ct.? For 36 ct.?

5. If there are 600 envelopes in a box and a box of envelopes cost 96 ct., how many envelopes can be bought for

16 ct.? For 48 ct.? For 36 ct.? If the envelopes are in packages of 25, how much does a package cost?

6. I bought a ream of paper at the rate of 6 sheets for 2 ct. and $\frac{1}{3}$ as many envelopes as sheets of paper at the rate of 2 ct. for 4 envelopes. What did I pay all together?

7. I wrote letters enough to use up 4 quires of paper, using 3 sheets for each letter. I put a 2-cent stamp on each envelope. What postage had I to pay?

8. I bought a ream of paper at 60 ct. a quire, and sold it at 5 ct. a sheet. How much did I gain or lose?

9. Eggs are sold at the rate of 35 for 54 ct. and purchased at the rate of 15 ct. a dozen. Find the price on the sale of 42 score eggs.

10. Make up the following bill:

100 sheets of paper at 10 ct. per quire.

425 envelopes at 8 ct. per package of 25.

220 pens at 9 ct. per dozen.

216 pencils at \$3.60 per gross.

11. A market woman took 12 dozen and 9 eggs to market. She broke 6 of them and sold the remainder at 27 ct. a dozen. How much did she receive?

12. In a large graded school there are 800 pupils. If each pupil be given 2 lead pencils, how many lead pencils will be left of a supply of 12 gross?

LL

Exercise 24

MEASURE OF ANGLES

60 seconds (") = 1 minute (').

60 minutes = 1 degree (°).

90 degrees = 1 right angle.

360 degrees = 1 circumference.

1. What name do you give the curved line in Figure A? What do you call the plane surface enclosed by this line? What is BC of the circle? What is A ? What is AD ? Compare the lengths of AB , AC , and AD . Make a statement about all the straight lines that may be drawn from A to the circumference of this circle. Is this statement true of all circles? Do you know any other name for the corner DAC ? How does it compare with the corner DAB ?

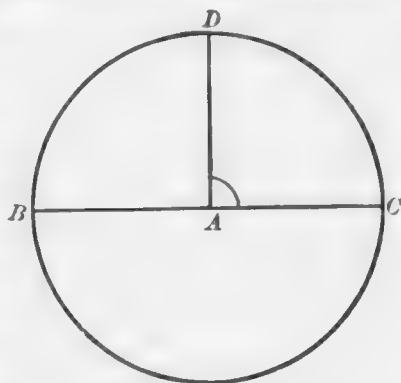


FIG. A

2. Make on the blackboard several *right angles*. Which are the largest? which the smallest? If what you have found is true for all right angles, make a statement of this truth.

NOTE. — An angle is the *measure* of the difference in direction of two straight lines.

3. Is the angle ABC of Figure B a right angle? Is it less or greater than a right angle? It is called an *acute angle*. Make several acute angles. Must all acute angles be equal? What is the greatest acute angle you can make? what is the smallest?



FIG. B

Is the angle ABC of Figure C a right angle? Is it an acute angle? How does it differ from both an acute and a right angle? It is called an *obtuse angle*. Make several obtuse angles in your exercise book. Compare them and make a statement as to their equality.



FIG. C

5. Name all the angles found in Figure D and state whether they are *acute*, *right*, or *obtuse*.

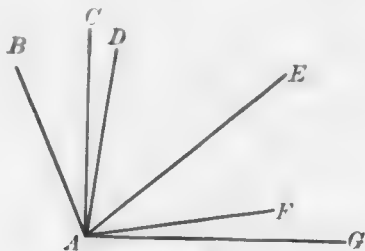


FIG. D

6. In Figure D what angle is the sum of the angles EAF and FAG ? DAG and BAD ? BAC and CAE ? CAD and DAF ?

7. In Figure D what angle is the difference between EAG and EAF ? EAG and FAG ? CAE and DAE ? CAE and CAD ? BAG and CAG ?

8. Were you comparing a 5-inch line and a 6-inch line you might say:

(a) A 5-inch line is shorter than a 6-inch line.

(b) A 5-inch line is $\frac{5}{6}$ of a 6-inch line.

Which is the more satisfactory (a) or (b)? Why?

9. Were you comparing the angles ABC and DEF of Figure E, you might say:

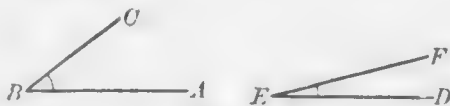


FIG. E

(a) The angle ABC is ——— than the angle DEF .

(b) The angle ABC is ——— ———.

What means of comparison is wanting in 9 that was present in 8? Can you suggest how this can be provided?

10. What do you call the angle ABC of Figure F? What is the relation of the line AB to the line BC ? The

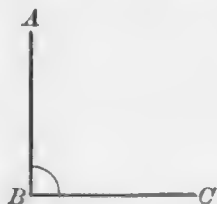


FIG. F

line BC to the line AB ? What must be the relation of the two *arms* (straight lines used in making the angle) of every right angle? When is one arm called *vertical* and the other *horizontal*?

11. In Figure G how many diameters do you find? What do you call the angles BOC , COA , AOD , and DOB ?

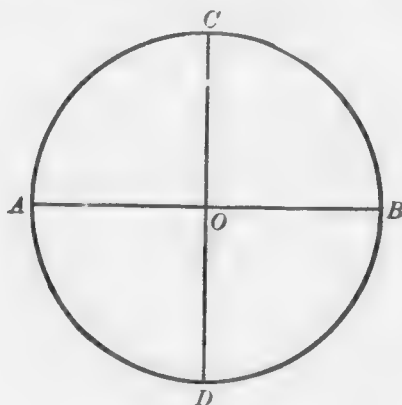


FIG. G

How many right angles can there be at the centre of a circle? at any point?

NOTE. — Each right angle may be divided into 90 equal parts called degrees. Each degree again into 60 equal parts called minutes, and each minute into 60 equal parts called seconds.

12. How many degrees is a circle? How do you prove this? If the circumference of the circle in Figure G were 360 inches, how much of the circumference would be opposite the angle BOC ? How much opposite the angle AOD ?

13. If a circle were divided into degrees, how much of the circumference would be opposite each degree, provided the circumference measured 720 feet? How much opposite 2 degrees? 10 degrees? 30 degrees? 180 degrees?

14. What is a degree? What is the difference between an angle of 30 degrees and a temperature of 30 degrees?

15. What part of a right angle is 15 degrees? 45° ? 75° ? 180° ? 360° ?

16. What part of a degree is 15 minutes? $20'$? $30'$? $45'$?

17. What part of a minute is 20 seconds? $30''$? $24''$? $18''$?

18. The circumference of a circle measures 360 inches. Find the size of the angle opposite:

- (a) 3 inches of the circumference.
- (b) 24 inches of the circumference.
- (c) 90 inches of the circumference.
- (d) 270 inches of the circumference.

19. How long does the earth take to *rotate* once? It therefore turns through how many degrees in how many minutes? It turns through one degree in how many minutes?

Exercise 25

In order to work this exercise the pupils will need to provide themselves with a protractor, a plan of which is given in Appendix B. The teacher will show each pupil how to place and read the protractor.

1. How many degrees are there in the angle formed by the hands of a clock at 2 o'clock? 3 o'clock? 7 o'clock? 4 o'clock in the afternoon? 4 o'clock in the morning?

2. Measure with the protractor the angles BDC and ADC

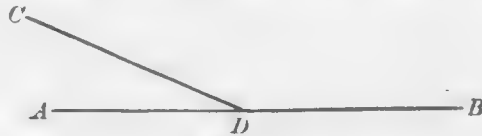


FIG. A

of Figure A. What is their sum? What do you call the line ADB ?

3. Measure each of the angles ABC , CBD , and DBC of Figure B. What is their sum? How many degrees are there in the sum of the angles ABD and DBE ? ABC and

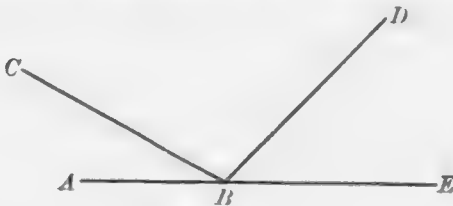


FIG. B

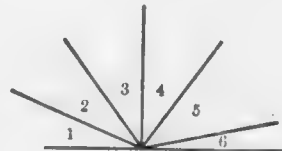


FIG. C

CBE ? By how much is the angle CBE less than two right angles? By how much is the angle CBE greater than a right angle?

4. What is the sum of the angles 1, 2, 3, 4, 5, and 6 of Figure C? Why do you think so? What is the sum of the angles 1, 2, and 3? Of 4, 5, and 6?

5. Measure the angles ABC and DBE . What have you found? Measure the angles CBD and ABE . What have

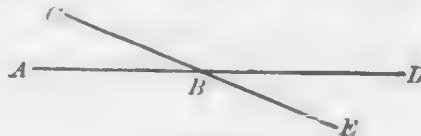


FIG. D

you found? How are the angles of these pairs of angles placed with relation to each other?

6. What do you call a 3-sided plane figure like Figure E? Do you know any name for the side CB ? What are AC and



FIG. E

AB called? Name the angles of the triangle ABC . Measure each. What is the sum of the 3 angles of the triangle ABC ? How many right angles is this equal to? Would you expect this to be true for all triangles?

7. Cut from paper a triangle similar to the one shown in Figure F. Cut off the corners, as shown by the dotted lines.

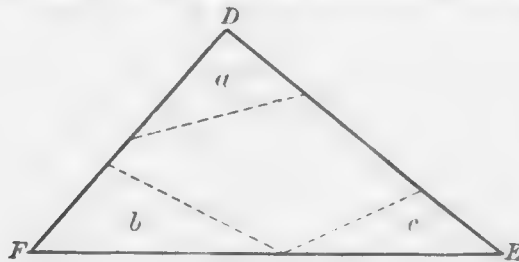


FIG. F

Rearrange the 3 angles, as shown in Figure G. What is the sum of the 3 angles of this triangle? Make a statement about the sum of the angles of any triangle.

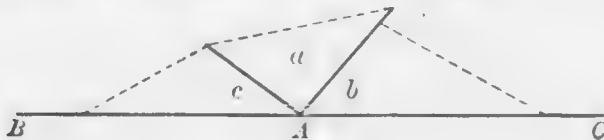


FIG. G

8. In Figure H the angle at C is a right angle. What is the sum of the angles A and B ? If B is 35° , what is A ? If A is 50° , what is B ?

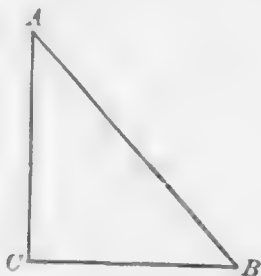


FIG. H

9. Using your protractor, construct the following fields on a scale of 30 rods to the inch:

(a) South side runs directly east and west and is 40 rods in length. The second side makes an angle of 75° with the south side and extends for 60 rods to the north-east. The third side extends directly eastwards 90 rods. The fourth side connects the eastern ends of the first and the third sides. Find in this plan the measurement of the other angles of the field.

(b) The south side is in the same position as the south side of A. The second side makes an angle of 60° with the south side at its western end. The third side connects the free ends of the first and second sides. The first and the second sides are each 60 rods long. What is the length of the third side? Compare the 3 angles of this triangle. Do you know a name for this triangle or any other having the same equal features?

10. Make an angle at A , of 65° . Make a similar angle at B , both angles to be on the same side of the line AB . Produce the arms until they meet. Compare:

- (a) The length of the sides of the triangle.
- (b) The angle at the vertex with the angle at the base.

Do you know the name of all triangles having the characteristics of this one?

Exercise 26**ENGLISH MONEY**

12 pence (*d.*) = 1 shilling (*s.*).

20 shillings = 1 pound (£).

NOTE. — £ 4 6*s.* 8*d.*

1. How many shillings are there in $2\frac{1}{2}$ pounds? in £ 3*½*? in £ 7*½*? in £ 10? in £ 14*½*? in £ 5*½*₁₆?
2. What part of a £ is 10 shillings? 12*s.*? 15*s.*? 16*s.*?
3. How many pence make a £?
4. How many shillings in £ 3 4*s.*? £ 5 6*s.*? £ 10 9*s.*?
5. How many pence in 3*s.* 4*d.*? 7*s.* 9*d.*? £ 2 3*s.* 6*d.*?
6. A farmer in England sold a cow for £ 8 10*s.*, a sheep at 17*s.* 6*d.*, and a pig at £ 1 3*d.* How much was received for all?
7. Add:
 - (a) £ 4 6*s.* 8*d.* + £ 9 13*s.* 8*d.* + £ 3 15*s.* 8*d.* + £ 7 25*s.* 10*d.*
 - (b) £ 3 3*s.* 2*d.* + £ 4 10*s.* 1*d.* + £ 7 2*s.* 5*d.* + £ 2 1*s.* 3*d.*
 - (c) £ 14 5*s.* 3*d.* + £ 2 3*s.* 7*d.* + £ 5 6*s.* 4*d.* + £ 27 14*s.* 8*d.*
 - (d) £ 7 8*s.* 2*d.* + £ 31 14*s.* 5*d.* + £ 10 13*s.* 4*d.* + £ 5 12*s.* 6*d.*
8. Subtract:
 - (a) £ 1 2*s.* 6*d.* from £ 1 10*s.* 9*d.*
 - (b) £ 15 12*s.* 9*d.* from £ 20 8*s.* 2*d.*
 - (c) £ 56 15*s.* 3*d.* from £ 61 12*s.* 1*d.*
 - (d) £ 82 13*s.* 9*d.* from £ 90.
9. Multiply:
 - (a) 7*s.* 6*d.* by 10.
 - (c) £ 15 10*s.* 8*d.* by 24.
 - (b) £ 3 18*s.* 9*d.* by 15.
 - (d) £ 14 13*s.* 11*d.* by 30.

10. Divide: (a) £58 1s. by 43.
(b) £117 16s. 8d. by 101.
(c) £169 6s. 8d. by 127.
11. Reduce: (a) 10s. 5d. to pence.
(b) £13 6s. 9d. to pence.
(c) £16 13s. to shillings.
12. Reduce :
(a) 116d. to shillings and pence.
(b) 2986d. to pounds, shillings, and pence.
(c) 1868s. to pounds and shillings.
13. If a cap is worth 2s. 8d., how many caps can be bought for £1 14s. 10d.?
14. If a book costs 6s. 4d., how much will 24 such books cost?
15. A pound of English money is usually equivalent to \$4.86 $\frac{2}{3}$ of Canadian money. A shilling of English money is worth 24 $\frac{1}{3}$ ct. of Canadian money. A penny of English money is worth about 2 cents of Canadian money. Change to Canadian money the following English money:
(a) £3 16s. 10d. (b) £7 18s. 8d. (c) £24 15s. 11d.
16. Change to English money:
(a) \$26.96. (b) \$36.41. (c) \$53.03.
17. Which system of money do you think the more convenient and why?
18. A merchant at Calgary purchased 720 yd. of English cloth at 7s. per yard. Freight and other expenses amounted to 10 ct. per yard. How much can he afford to sell the cloth at per yard to make a profit of \$28.40 above all expenses?

NOTE. — American money consists, like Canadian money, of dollars and parts of dollars.

Exercise 27 (Review)

1. What weights or measures do you use in buying milk, potatoes, vinegar, butter, eggs, paper, nails, cotton, buttons, wheat, coal oil, gold, drugs, flour, land, grapes, and iron?

2. How many :

Ounces in a pound? Pounds in a bushel of peas? Pounds in a ton? Shillings in a dollar? Cubic feet in a cord? Feet in a mile? Feet in a chain? Square feet in a square yard? Single things in a gross?

3. If oats cost 32 cents a bushel, find what it will cost to supply oats enough for the month of December, the horse being able to eat 6 quarts a day.

4. Which would you rather sell, 2000 bushels of wheat at 60 ct. a bushel or at \$1.05 per 100 lb.? How much would you be the gainer on the whole sale?

5. A grocer bought 120 bushels of potatoes at 45 ct. a bushel and sold them at 15 ct. a peck. How much did he make?

6. At 6 o'clock February 8th, 1904, the thermometer stood at 18° below 0. On June 28th, it stood at 83° above 0. Find the difference in the temperature of these dates.

7. What does "10 degrees below" mean when applied to a thermometer?

8. How many feet are there in :

- (a) 2 miles? (c) 800 yards? (e) 96 hands?
(b) 120 rods? (d) 15 chains? (f) 1260 inches?

9. How many yards in :

- (a) 3 miles? (c) 20 chains?
(b) 80 rods? (d) 972 feet?
(e) 7236 inches?

10. How many tons in :

- (a) 4500 pounds? (b) 60 cwt.?
(c) 64,000 ounces?

11. How many pounds in :

- (a) 6496 ounces? (b) 11 cwt.?
(c) 22 tons?

12. How many acres in a block of land :

- (a) 800 rods by 240 rods?
(b) 2 miles by $\frac{1}{2}$ a mile?
(c) 40 chains by 20 chains?

13. Find the number of days from :

- (a) June 15th to September 11th.
(b) January 10th to February 21st.
(c) February 3d, 1920, to March 3d, 1920.

14. A pile of wood lies along a steep hillside. The length of the pile measured along the ground is 8 feet. The vertical height of each end is 4 feet. Is there a cord of wood in the pile?

SUGGESTION. — Make a diagram.

Exercise 28 (Review)

1. Find the cost of :

- (a) 127 yards of carpet at \$1.25 per yard.
(b) 9 lb. 12 oz. butter at 24 ct. a pound.
(c) 225 eggs at 20 ct. a dozen.

2. How many :

- (a) Yards in 1863 feet?
(b) Quarts in 9640 pints?
(c) Hours in 2580 minutes?
(d) Bushels in 3664 pecks?

3. Which of the following are leap years: 1854, 1800, 1876, 1926, 1960, and 1976? How did you determine each?

4. How many degrees does the minute-hand of a watch move in half an hour? A quarter of an hour? 24 minutes?

5. How many degrees does the earth turn in 12 minutes? In an hour? In a quarter of a day?

6. A field is 180 rods long and 20 chains wide. How much wheat will it produce at the rate of 23 bushels to the acre?

7. If $\frac{3}{4}$ of 12 bushels of wheat sell for \$6.48, find the selling price of 120,240 pounds of wheat.

8. A 3-inch cube was painted on every side. It was then sawn into inch cubes. Find:

(a) How many of the inch cubes were painted on three sides.

(b) How many were painted on two sides.

(c) How many were painted on one side.

(d) How many were not painted at all.

9. At \$5.75 a cord, find the value of all the wood that can be piled under a shed 64 feet long, 25 feet wide, and 12 feet high.

10. The surface of a cube is 216 square feet; find its size.

Exercise 29 (Review)

1. Find the cost of:

(a) 1750 pounds of hay at \$8 a ton.

(b) 100 loads of gravel, each containing 32 cubic feet, at \$2 a cord.

2. A woman gave 6 pounds of butter, worth 25 cents a pound, for 5 gallons of oil. What would a barrel of oil cost at this rate?

3. Farmer Brown has a field 80 rods long, containing 10 acres. Farmer Jones has a field 40 rods long, containing $1\frac{1}{2}$ acres. Find the cost in each case of fencing the field at 85 cents a rod. What statement can you make from these results?

4. How many apples must I buy and sell to make a profit of \$5 if I buy at the rate of 6 apples for 5 cents and sell at the rate of 5 apples for 5 cents?

5. Find the following dates:

(a) 60 days after June 1st.

(b) 3 months and 5 days after April 15th.

6. A farmer placed in a box $\frac{5}{8}$ of a bushel of wheat, $\frac{2}{3}$ of a bushel of peas, and $\frac{3}{4}$ of a bushel of barley; what weight of grain was in the box?

7. If in quick marching soldiers take 120 steps of 30 inches each to the minute, how far will they walk in $2\frac{1}{2}$ hours?

8. If All Fools' Day be on Friday, on what day of the week will Dominion Day fall? Christmas Day? New Year's Day? Empire Day?

9. A farmer bought 40 sacks of oats, each weighing 170 pounds, at 80 cents a bushel. What had he to pay?

10. A man had to go a journey of 70 miles. The first day he travelled 17 miles 200 rods; the second, 20 miles 60 rods; and the third, 21 miles 60 rods. How much farther had he to go?

11. A wood merchant has three piles of wood. The first is 80 feet long, 12 feet high, and 8 feet wide; the second contains 3 times as much wood, and the third half as much as the first and second. If $\frac{1}{2}$ the wood is tamarack, worth \$6.50 a cord; $\frac{1}{3}$ Jackpine, worth \$5.75 a cord; and the remainder poplar, worth \$5 a cord, find the total value of the wood in the yard.

12. Find the cost of feeding 36 horses for 24 weeks, when hay is \$8 a ton and oats 35 ct. a bushel, if a horse eats 20 lb. of hay and 2 gallons of oats per day.

13. A gang of men were set at digging a ditch 10 miles in length. They dug at the rate of 40 rods per day during the months of June and July. How much of the ditch remained to be dug at the end of this time, provided June began on a Monday and the men rested on Sunday?

14. If it costs \$1.40 less to build a fence 70 rods long than a fence 396 yards long, how much at the same rate will it cost to build a fence round a field containing 60 acres if the width of the field be 45 rods?

15. The front wheel of a wagon is 6 ft. in circumference, the hind wheel is 9 ft. in circumference. How many more turns will the front wheel make than the hind wheel in going a distance of 6 mi. 180 rd.?

MENSURATION

Exercise 30

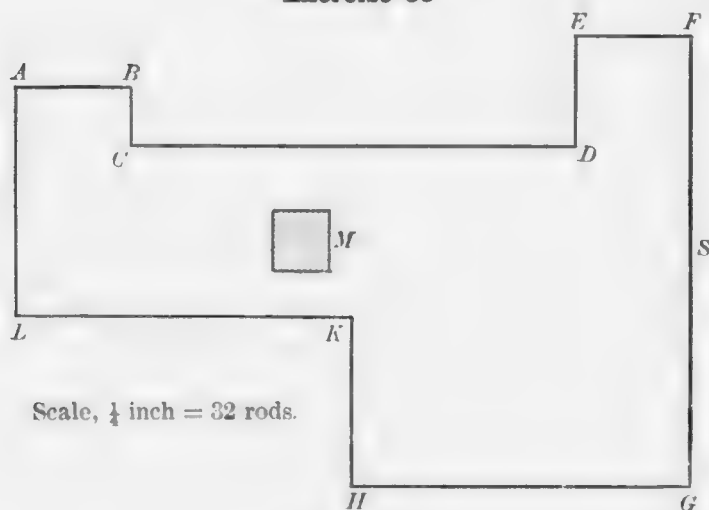


FIG. A

1. Find in rods the perimeter of the farm in Figure A. Find this also in miles.
2. If 4 acres in a strip along the side AL were to be sold, how wide would this strip be?
3. If 24 acres were to be sold in one strip off the side FG , how wide would the strip need to be?
4. If the rectangle $DEFG$ were completed by extending the fence ED to meet the fence GH , how many acres would it contain?
5. If the rectangle GHK were completed by building the fence LK so as to meet the side FG , how many acres would it contain?
6. If the rectangle $LABU$ were completed by extending BC , how many acres would it contain?
7. If, after the fence BU was extended, the owner also extended the fence HK , how many acres would there be in the rectangle CK ?
8. How many acres in the whole farm?
9. If the fence HK were continued to meet the fence CD and the fence CD were extended to meet the fence FG , how many cows could be pastured in the square field thus formed to the south-east if 8 acres will pasture 3 cows?
10. If the square field to the north-east be used as a pasture field for sheep, how many sheep will it support if each sheep requires a space of 32 square rods?
11. How many fence posts set half a rod apart will be required to fence the farm?
12. If wire fencing, costing \$2.15 per 16 rods of single wire, be strung along the posts, how much will it cost to place six wires around the farm?
13. M is an artificial lake. Find M 's area in square rods. Change this area to square feet.

14. If the water is 10 feet deep, how many cubic feet of water are there in M ?

Exercise 31



FIG. B

The diagram in Figure B represents a room 24 yd. long by 12 yd. wide.

1. If the carpet be placed so that the strips will run from end to end as in Figure B, how many strips will be necessary if the carpet is one yard wide? How many if the carpet is 24 inches wide? 18 inches wide? 27 inches wide? 16 inches wide?

2. What length of carpet will be required for one strip in all the cases given in question 1?

3. How many yards of carpet will cover the room in Figure B if the carpet is one yard wide? 2 feet wide? 27 inches wide? 18 inches wide?

4. What will it cost to carpet the same room with carpet 27 inches wide if the carpet costs \$1.15 per yard?

NOTE. — Carpets are sold by the *linear* yard.

5. What will it cost to carpet the same room with carpet a yard wide at \$2 per yard? Carpet 24 inches wide at 85 ct. per yard?

6. Make a diagram showing how many strips of carpet a yard wide could be placed on the floor of a room 24 yd. long and 12 yd. wide, the strip to extend across the width of the room.

7. How many strips would be necessary were the carpet 27 in. wide? 2 ft. wide? 18 in. wide?

8. How many yards of carpet will it take if:

- (a) The carpet is 36 in. wide?
- (b) The carpet is 27 in. wide?
- (c) The carpet is 24 in. wide?
- (d) The carpet is 18 in. wide?

Compare these results with the results of question 3.

9. What will it cost to carpet this room with carpet:

- (a) A yard wide if the carpet costs \$2 a yard?
- (b) 27 in. wide if the carpet costs \$1.15 a yard?
- (c) 24 in. wide if the carpet costs 85 ct. a yard?

Compare these results with those of questions 4 and 5, and state what you have found.

10. If carpet is laid lengthwise on a room 24 yd. long and 15 yd. wide, how many widths or strips will be necessary when the carpet is 30 in. wide?

NOTE. — The carpet dealer will not cut a strip.

11. If the same carpet be laid in strips across the room, how many strips will be required? What width must be turned under in this case?

12. How will you lay the following carpets so as to save cutting or turning under:

- (a) Carpet 27 in. wide placed on a room 18 yd. long and 12 yd. wide?
- (b) Carpet 30 in. wide placed on a room 36 ft. by 30 ft.?
- (c) Carpet 24 in. wide placed on a room 36 ft. by 25 ft.?
- (d) Carpet 25 in. wide placed on a room 50 ft. by 40 ft.?

Exercise 32

1. How many widths of carpet $\frac{3}{4}$ of a yard wide will it take to extend across the width of a room 9 yd. wide? 30 ft. wide? 21 ft. wide? 26 ft. wide?

2. How many widths of carpet $\frac{2}{3}$ of a yard wide will it take to extend across a room 18 yd. long? 20 ft. long? 21 ft. long? 15 yd. long?

3. What is necessary to know regarding questions 1 and 2 to enable you to find how many yards of carpet you would have to purchase?

4. A room is 24 ft. wide. How many strips of carpet running lengthwise can be laid down on its floor if the carpet is 24 in. wide? If the room is 30 ft. long, how many yards of carpet will be needed? How much more carpet would be needed were the room a foot wider? Were the room a foot longer?

5. How many yards of carpet 27 in. wide are required for a room:

(a) 54 ft. by 37 ft.?

(c) 36 ft. by 27 ft.?

(b) 48 ft. by 36 ft.?

(d) 27 ft. by 24 ft.?

In each of the above cases how should the carpet be laid?

6. How many yards of carpet $\frac{2}{3}$ of a yard wide are required for a room:

(a) 30 ft. long by 27 ft. wide?

(b) 42 ft. long by 33 ft. wide?

(c) 49 ft. long by 19 ft. wide?

7. Find the cost of carpeting the following rooms with carpet a yard wide, at \$1.80 per yd.:

(a) 24 ft. by 21 ft.

(b) 27 ft. by 18 ft.

8. If it costs \$270 to carpet a room 18 ft. wide with carpet a yard wide worth \$1.50 a yard, how long is the room?

9. How much would it cost to carpet the floor of the schoolroom with carpet 30 inches wide worth 95 ct. a yard?

10.

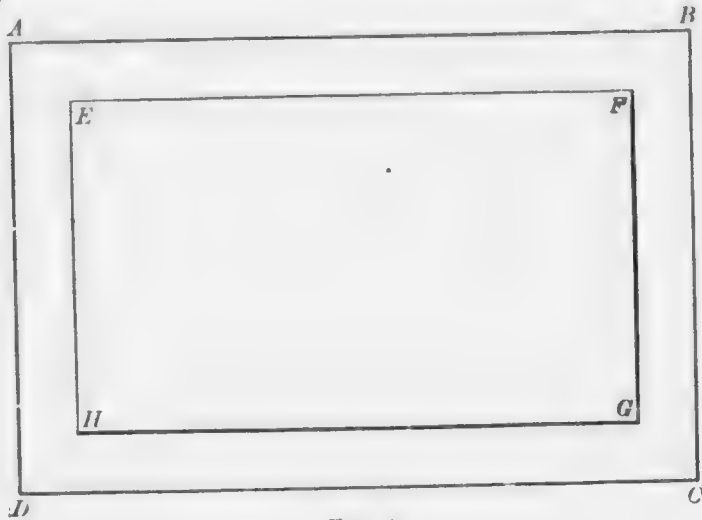


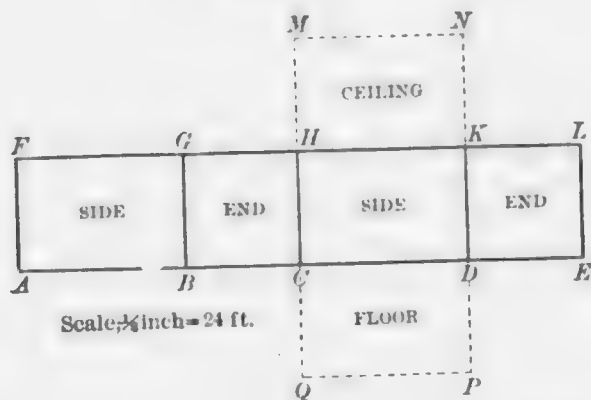
FIG. A

Figure A is the plan of a room 72 ft. long. *EFGH* is a rug. Find :

- (a) The number of square yards of material in the rug.
- (b) The area of the room *ABCD*.
- (c) The area of the border surrounding the rug.
- (d) The value of the rug at \$4 per square yard.
- (e) The cost of painting the border at 9 ct. per square yard.

11. Find the cost of carpeting a stairway having 20 steps, each having an 8-inch *rise* and a 10-inch *tread*, the carpet to cost 90 ct. a yard, an extra yard being allowed for the landing.

Exercise 33



PLAN OF WALLS, FLOOR, AND CEILING OF A ROOM

FIG. A

How long is AF ? What is the length of AE ? What is the length and width of the ceiling? Of the floor?

1. A room is 18 ft. long, 15 ft. wide, and 8 ft. high. Find :
 - (a) The area of the four walls.
 - (b) The area of the ceiling.
 - (c) The area of the floor.

2. How many strips of paper 24 inches in width will be required to be cut for the walls of the room described in question 1?

3. How many strips of the same paper will be required for the ceiling, provided the strips run from side to side?

4. How long are the strips found in question 2? How long are those of question 3? How many yards of wall paper will it be necessary to purchase? How many rolls of paper will be required provided a single roll has 8 yd. of paper? How many double rolls?

NOTE. — The dealer will not take back a part of a roll.

5. How many yards of paper 27 inches wide will be required for the walls of a room 30 ft. long, 21 ft. wide, and 12 ft. high? Make a plan of this room.

6. How many yards of paper will be required for the walls of a room 40 ft. long, 36 ft. wide, and 15 ft. high if the paper is 30 inches wide? How many 8-yard rolls will have to be purchased? What is this worth at 15 ct. a roll?

7. How many yards of paper 24 inches wide will be required for the ceiling of a room:

(a) 24 feet by 16 feet?

(b) 36 feet by 28 feet?

8. Find the cost of papering the walls and ceiling of the following rooms with paper 30 inches wide, the paper costing 35 cents per 8-yard roll:

(a) 30 feet long, 20 feet wide, 15 feet high.

(b) 35 feet long, 30 feet wide, 12 feet high.

(c) 42 feet long, 40 feet wide, 18 feet high.

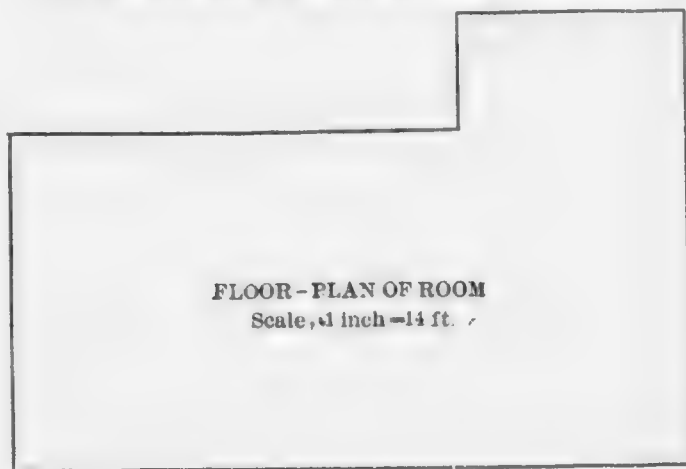


FIG. B

9. Figure B is the ground plan of a room 12 feet high. Find:

(a) The cost of carpeting the floor with carpet 27 inches wide at \$1.80 a yard, the carpet to be laid from end to end of the room.

(b) The cost of papering the walls with paper 24 inches wide at 30 cents per 8-yard roll.

(c) The cost of painting the ceiling at 18 cents per square yard.

10. A room 15 feet high has 6 walls whose lengths are 12, 15, 18, 24, 30, and 36 feet respectively. What will it cost to paper the walls of this room with paper $\frac{3}{4}$ of a yard wide at 35 cents per 8-yard roll, the paper-hanger charging 10 cents per square yard for hanging the paper?

Exercise 34

1. How many square yards of plastering are there in the walls of the following rooms :

(a) A room 18 ft. by 12 ft. and 9 ft. high ?

(b) A room 24 ft. by 18 ft. and 12 ft. high ?

2. How many square yards of plastering are there in the ceilings of rooms :

(a) 21 ft. long by 18 ft. wide ?

(b) 63 ft. long by 45 ft. wide ?

3. If it costs 24 ct. per square yard, find the cost of plastering the walls of a room :

(a) 36 ft. long by 27 ft. wide.

(b) 45 ft. long by 36 ft. wide.

4. If plastering is rated at 26 ct. per square yard, how much will it cost to plaster the walls and ceiling of a room :

(a) 54 ft. long by 45 ft. wide ?

(b) 72 ft. long by 63 ft. wide ?

5. Find the cost of cementing the floor of a cellar :

(a) 27 ft. long by 21 ft. wide at \$3 per sq. yd.

(b) 81 ft. long by 72 ft. wide at \$4.50 per sq. yd.

6. How many square yards of plastering in a room 45 ft. long, 36 ft. wide, and 12 ft. high, provided there are 2 doors each 6 ft. by 3 ft. and 3 windows each 4 ft. by 3 ft. ?

NOTE. — In plastering it is usual to consider the walls as entire, since what is saved in plaster is made up by the extra difficulties of plastering about windows, doors, etc.

7. If the plasterer charges 12 ct. per square yard for putting on each coat of plaster, find what it would cost to put two coats of plaster on the walls and ceiling of a room :

(a) 30 ft. long by 18 ft. wide, and 15 ft. high.

(b) 108 ft. long by 90 ft. wide, and 10 ft. high.

8. A room 60 ft. long, 48 ft. wide, and 15 ft. high contains 160 people. Find :

(a) How many sq. ft. of floor space there are for each.

(b) How many cu. ft. of air space there are for each.

9. The wall surface of a room 15 ft. wide and 12 ft. high is 160 sq. yd. Find the length of the room and also its perimeter.

Exercise 35

NOTE. — A single *foot* of lumber would be a piece of board *one foot square and one inch thick*. Such a piece of lumber is called a *board foot*.

1. How many *board feet* in the following pieces :

(a) A board 12 ft. long, 1 ft. wide, and 1 in. thick ?

(b) A board 16 ft. long, 2 ft. wide, and 1 in. thick ?

(c) A board 8 ft. long, 6 in. wide, and 1 in. thick ?

2. How many inch boards could be sawn from the following pieces, no allowance being made for waste in sawing :

- (a) A piece 18 ft. long and 1 ft. square ?
- (b) A piece 15 ft. long and 6 in. square ?
- (c) A piece 12 feet long and 9 in. square ?

3. How many board feet are there in the following planks :

- (a) A plank 15 ft. long, 1 ft. wide, and 2 in. thick ?
- (b) A plank 18 ft. long, 2 ft. wide, and 3 in. thick ?
- (c) A plank 12 ft. long, 1 ft. wide, and 4 in. thick ?

4. How many thousand board feet are there in 2000 boards having the following dimensions :

- (a) Boards 12 ft. long, 1 ft. wide, and 1 in. thick ?
- (b) Boards 15 ft. long, 2 ft. wide, and 3 in. thick ?
- (c) Boards 18 ft. long, 8 in. wide, and 1 in. thick ?

5. How many thousand feet of lumber are there in :

- (a) 600 boards, each 15 ft. long, 1 ft. wide, and $\frac{1}{2}$ in. thick ?
- (b) 800 boards, each 20 ft. long, 9 in. wide, and 2 in. thick ?
- (c) 1500 boards, each 12 ft. long, 8 in. wide, and 3 in. thick ?

6. How many feet of lumber in :

- (a) A plank 15 in. wide, 16 ft. long, and $2\frac{1}{2}$ in. thick ?
- (b) A plank 10 in. wide, 12 ft. long, and $3\frac{1}{2}$ in. thick ?
- (c) A joist 15 ft. long, 4 in. wide, and 3 in. thick ?

7. How many feet of boards will it take for the floor of a room :

- (a) 22 ft. long, 14 ft. wide, allowing 20 sq. ft. for waste ?
- (b) 25 ft. long, 18 ft. wide, allowing 35 sq. ft. for waste ?
- (c) 30 ft. long, 20 ft. wide, allowing 45 sq. ft. for waste ?

8. How much lumber will it take to build the walls of the following houses if the space left for windows and doors will equal the waste in fitting:

- (a) A house 24 feet long, 20 feet wide, and 10 feet high?
- (b) A house 27 feet long, 21 feet wide, and 11 feet high?
- (c) A house 35 feet long, 30 feet wide, and 12 feet high?

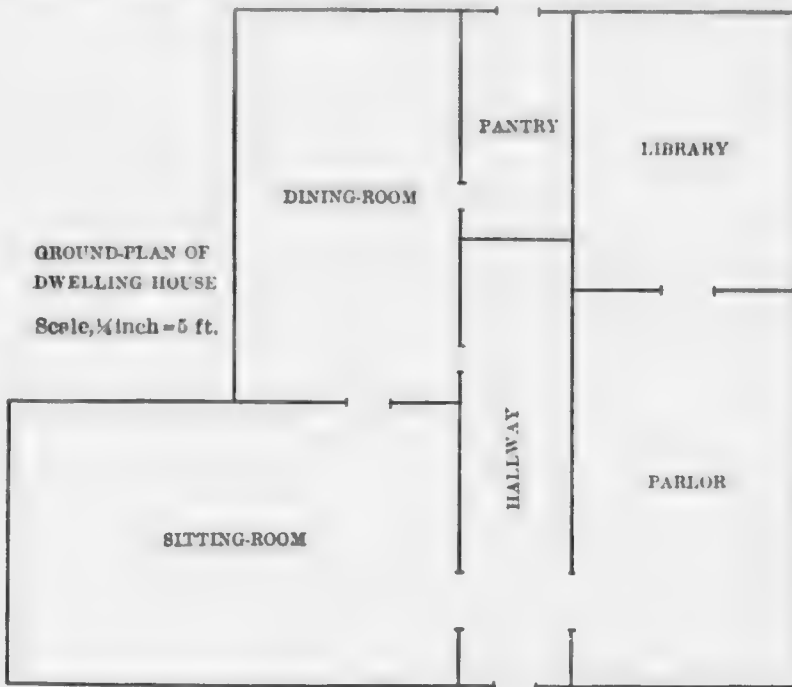


FIG A

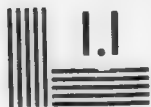
9. In the floor-plan of Figure A, find (no allowance being made for waste of material or thickness of walls):

- (a) The cost of flooring the parlor with maple at \$30 per M. (M = 1000 feet.)
- (b) The cost of flooring the sitting room with ash at \$40 per M.
- (c) The cost of flooring the dining room with oak at \$50 per M.



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(d) The cost of flooring the hallway with ash at \$45 per M.

(e) The cost of flooring the pantry with oak at \$45 per M.

10. Find the total cost of laying the foregoing floors at \$2 per square of 100 square feet.

11. How many feet, board measure, are there in 1000 scantlings:

(a) 15 feet long, 3 inches square?

(b) 12 feet long, 4 inches by 3 inches?

(c) 10 feet long, 4 inches square?

12. How many feet of lumber in a pile of inch boards:

(a) 6 ft. wide, 4 ft. high, and 15 ft. long?

(b) 5 ft. 3 in. high, 5 ft. wide, and 10 ft. long?

(c) 6 ft. high, 3 ft. wide, and 12 ft. long?

13. How many feet of lumber will be required to build the following sidewalks if the walks be laid on 3 scantlings each 4 inches by 3 inches:

(a) 600 yd. long and 6 ft. wide (lumber 1 in. thick)?

(b) Half a mile long and 8 ft. wide (lumber 2 in. thick)?

(c) 5 mi. long and 12 ft. wide (lumber $1\frac{1}{2}$ in. thick)?

14. How many shingles laid 4 in. to the weather will cover a roof:

(a) 24 ft. long and 15 ft. wide?

(b) 32 ft. long and 20 ft. wide?

(c) 36 ft. long and 25 ft. wide?

NOTE.—250 shingles, each 4 inches wide make a bunch. Four bunches of shingles laid 4 inches to the weather cover 100 square feet.

15. Make a diagram on the blackboard showing that you understand what is meant by *placing shingles 4 inches to the weather*.

16. If when I lay shingles 4 in. to the weather I require 1000 shingles to cover 100 sq. ft., how many square feet will be covered by 1000 shingles when :

- (a) The shingles are laid 5 inches to the weather ?
- (b) The shingles are laid 3 inches to the weather ?

Exercise 36



FIG. A

1. What kind of line is AB ? What kind is CD ? How far is AB from CD ? Lines equally distant from one another at every point are said to be *parallel*. Mention cases of parallel lines in the schoolroom. Mention cases of parallel lines outside the schoolroom. Can curved lines be parallel?

2. What do you call the four-sided figure B ? Which sides are *parallel*? Which sides are equal? What do you call the angles A, B, C , and D ?

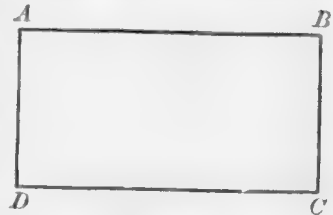


FIG. B

3. Look at figure C. How does it resemble a rectangle? How does it differ from a rectangle? Measure with your protractor the angles B and D . What did you find? Measure also the angles A and C . What did you find? Make a statement respecting what you have found regarding these pairs of angles.

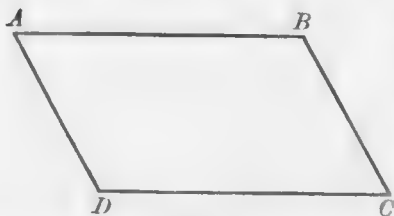


FIG. C

4. How does the side AD (Fig. C) compare in length with the side BC ? How does the side AB compare in

length with the side CD ? Make a statement concerning the opposite sides of this figure.

5. How far is the side AB from the side CD (Fig. C)? What do you call lines drawn in the positions of the lines AB and CD ? Does the same thing hold good for the lines BC and AD ?

6. Compare again the figures used in questions 2 and 3, pointing out wherein they resemble each other, and wherein they differ. Write down what you have found.

NOTE. — All four-sided plane figures whose opposite sides are parallel to each other are called *parallelograms*.

7. Is a square a parallelogram? Is a rectangle a parallelogram? Are all parallelograms rectangles or squares?

8. Figure D is a parallelogram. The side CD is called the *base*, and the height, measured by the line BG ,

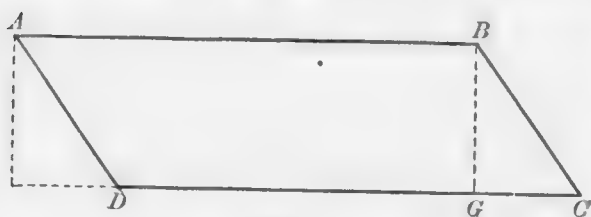


FIG. D

is called the *altitude*. If the parallelogram be cut straight across along the line BG , and the part BGC be placed at

the left as in ADH , the parallelogram may be changed into a rectangle. Verify the truth of this by cutting papers into the form of $ABCD$ and afterwards changing them into the form $ABGH$.

9. What is the area of a parallelogram whose base is 12 feet and altitude 8 feet? (Study the figure given under question 8.)

10. How many square yards are there in a piece of land in the form of a parallelogram if two opposite parallel sides are 40 yards long, and the distance between them is 15 yards?

Make a diagram on the board showing the *two opposite sides* and the *distance between them*. If the other two opposite sides are 30 yards long, what must be the distance between them?

11. How many triangles do you find in Figure E? What has divided the parallelogram into these triangles? What name do you give the line AC ?

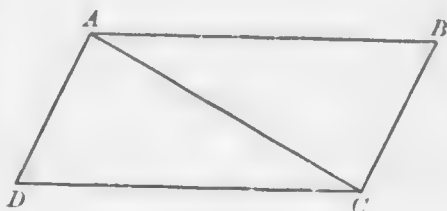


FIG. E

12. How does the triangle ABC compare in shape and size with the triangle ACD ? Verify this by using a piece of paper cut in the form of a parallelogram. What part of the parallelogram $ABCD$ is the triangle ABC ? What part is the triangle ACD ?

13. What is the *base* of the triangle ACD ? What is the base of the parallelogram $ABCD$? What is the altitude of the parallelogram $ABCD$? What the altitude of the triangle ACD ?

14. Pin two sheets of paper together. On one outline the boundaries of any triangle. Take the scissors and cut through both sheets, along the sides of the triangle. How do the triangles compare in size? Place them so as to form a parallelogram. Which have the greater base, the triangles or the parallelogram made from the triangles? Which the greater altitude?

15. Make a statement covering what you have seen to be true regarding the relation of a triangle to a parallelogram of the same base and altitude.

16. If the area of a parallelogram be 80 sq. yd., what should be the area of a triangle having the same base and altitude?

17. Change this triangle into a parallelogram. Write a description of what you had to do, and why and how you did it.

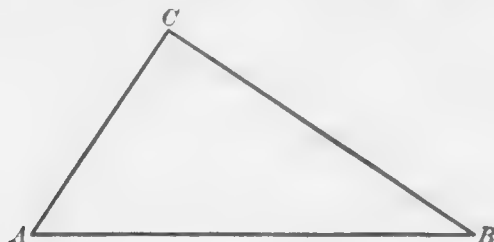


FIG. F

18. Find the area of :

- (a) A triangle whose base is 20 ft. and altitude 10 ft.
- (b) A triangle whose base is 30 yd. and altitude 15 yd.
- (c) A triangle whose base is 60 yd. and altitude 50 yd.

19. Find the altitude of the following triangles :

- (a) Area of triangle 90 sq. ft., base 10 ft.
- (b) Area of triangle 144 sq. ft., base 16 ft.
- (c) Area of triangle 72 sq. ft., base 8 ft.

20. Find the base of the following triangles :

- (a) Altitude 10 ft., area 80 sq. ft.
- (b) Altitude 12 ft., area 120 sq. ft.
- (c) Altitude 8 yd., area 24 sq. yd.

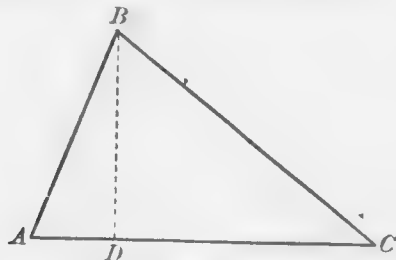


FIG. G

21. A piece of land (Fig. G) is in the form of the triangle ABC . The side AC is 96 rods, and the distance from D to C 80 rods. BD is 40 rods. Find :

- (a) The area of the triangle ABD in acres.
 (b) The area of the triangle BDC in acres.

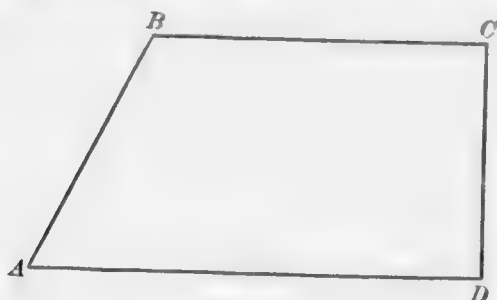


FIG. H

22. Brown's farm is shaped like Figure H. CD is 160 rods in length. Find the area of the farm.

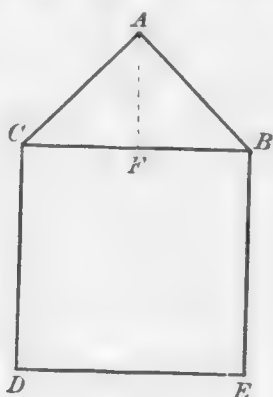


FIG. I

23. Figure I represents the end of a house. Find:
 (a) The area of the gable if $DE = 24$ ft. and $AF = 12$ ft.
 (b) The area of $BCDE$ if $BE = 24$ ft.
24. If the house (Fig. I) is 40 ft. long, the edge of the roof, AB , 18 ft., and the length of the roof 42 ft., find:
 (a) How much inch lumber will cover the ends, including the gables.

(b) How much inch lumber will cover the two sides and the roof.

(c) How many shingles set 4 inches to the weather will be needed for the roof.

Exercise 37

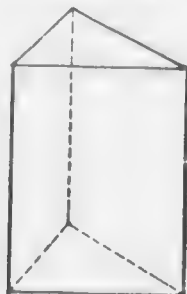


FIG. A

1. Describe the end of the prism. How many sides has a triangular prism? What other kinds of prisms are there?
2. Compare the area of the two ends of any prism.
3. If the triangular surface of a prism be 4 inches across the base and 5 inches in altitude, what is its area? If 5 inches across the base and 4 inches in altitude, what is its area?
4. Describe the three faces of a triangular prism.
5. If the perimeter of the triangle forming one end of a triangular prism be 24 inches in length, and the length of the prism be 12 inches, find the total area of the faces. What is the entire surface of this prism if the base of the triangular end is 8 inches and the altitude 6 inches?
6. If the area of the end of a prism be 6 square inches and the length of the prism be 8 inches, find the number of cubic inches in the prism.
7. The base of the triangular end of a prism is 12 inches, the altitude is 8 inches; find the area of the triangle. If the prism is 15 inches long, find its *volume* in cubic inches.

8. Figure B represents the gable end of a barn 60 ft. long. The plan is drawn to a scale of 20 ft. to an inch; find in cubic feet the volume of the roof portion of the barn.

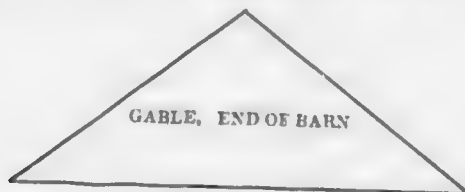


FIG. B

9. Find the area of the end of a triangular prism:
- (a) 20 inches long and of volume 400 cubic inches.
 - (b) 15 inches long and of volume 90 cubic inches.
 - (c) 13 inches long and of volume 364 cubic inches.

Exercise 38

1. A brick is 8 inches long, 4 inches wide, and 2 inches thick; find how many bricks there are in:
 - (a) A pile 48 ft. long, 16 ft. wide, and 6 ft. high.
 - (b) A pile 32 ft. long, 12 ft. wide, and 3 ft. high.
 - (c) A load 70 ft. long, 2 ft. deep, and 3 ft. wide.
2. How many bricks of the foregoing dimensions can be piled under a shed 40 ft. long, 8 ft. wide, and 8 ft. high? In how many ways may we place the bricks?
3. How many wagon loads of cordwood, 96 cubic feet to a load, in a woodpile 224 ft. long, 12 ft. wide, and 8 ft. high? What will this wood cost a merchant who pays \$5.65 a cord on the ground and 60 ct. a load for cartage?
4. What will it cost to dig a cellar 36 ft. long, 24 ft. wide, and 6 ft. deep at 65 ct. per cubic yard?
5. A surveyor in measuring the length of a road finds that it is 800 chains long. How long is it in miles?

6. Beneath a house 36 ft. long and 24 ft. wide is a stone foundation 2 ft. thick and 8 ft. high. Find how many cubic feet of stone there are in the foundation.

SUGGESTION. — Make use of the outside and inside measurements of the wall.

7. What will it cost to plaster a room 32 ft. long, 27 ft. wide, and 9 ft. high at 15 ct. per square yard, the ceiling included and no allowance made for windows and doors?

8. How many rolls of paper 8 yd. to a roll will be required for the walls and ceiling of a room 48 ft. long and 36 ft. wide if the paper is 2 ft. wide? What will this cost if a roll of paper is worth 30 ct. and the paper-hanger charges 3 ct. per square yard?

9. If 2 thousand laths cover 98 square yards of surface, and 10 pounds of nails nail them on, what will it cost to lath the walls and ceiling of a room 84 ft. long, 63 ft. wide, and 18 ft. high if the laths cost \$3 a thousand, the nails 8 ct. a pound, and the labor 5 ct. a square yard?

10. How many shingles laid 4 inches to the weather will be required for each roof of a house 60 ft. long and 45 ft. wide?

NOTE. — 1000 shingles laid 4 inches to the weather will cover 100 square feet of surface.

11. At \$20 per rod find the cost of the lumber required to enclose a field of 80 acres with a tight board fence, the boards to be 5 feet long, 6 inches wide, and an inch thick. The field is 80 rods wide.

SUGGESTION. — Change the rods to miles and miles to feet.

12. Will it take more or less if the boards were a foot wide?

13. What will it cost to carpet a room 72 ft. long by 39 ft. wide with carpet 27 in. wide at \$2 per yard, the strips to run the length of the room?

BILLS, ACCOUNTS, AND AVERAGES

Exercise 39

1. Find the amount of the following items:

15 bbl. of flour at \$6.50 per barrel.
300 lb. of sugar at 15 lb. for \$1.
75 bu. of wheat at 75 ct. per bushel.
87 bu. of oats at 30 ct. per bushel.
200 lb. raisins at 9 ct. per pound.

2. I purchased at a grocery store the following:

17 lb. of tea at 65 ct. per pound.
12 squares of comb honey at 20 ct. per square.
6 lb. of coffee at 35 ct. per pound.
19 lb. 12 oz. butter at 24 ct. per pound.
28 lb. bacon at 16 ct. per pound.
13 lb. rice at 8 ct. per pound.
7 doz. oranges at 30 ct. a dozen.

I gave in exchange:

6 bu. of potatoes at 56 ct. per bushel.
25 lb. turkey at 18 ct. per pound.

Find how much I must pay to settle the debt.

3. I deposited in the Post Office Savings Bank at various times the following sums: \$300, \$86.95, \$235.80, \$400, \$595.60, and \$18.50. I received as interest on my deposit \$3.85, \$4.25, \$5. I withdrew \$29, \$37.50, and \$60. How much have I still to my credit at the bank?

4. My monthly salary is \$150. I expend during the month the following sums: \$25 for rent, \$27.60 for food, \$18.75 for clothing, \$3.25 for light, \$7.20 for fuel, \$12 for servant's wages, and \$6.30 for other incidentals. How much can I bank each month?

5. Toronto, February 1st, 1904.
R. T. Hodgson,

Bought of James McDougall and Co.

Jan.	3	17 gal. coal oil	@ 35 ct.	85	95		
"	13	26 lb. butter	@ 28 ct.	7	28		
"	20	14 doz. oranges	@ 20 ct.	2	80		
"	28	15 lb. tea	@ 45 ct.	6	75	822	78
		<i>Received payment,</i>					
		<i>February 1st, 1904.</i>					
		<i>James McDougall & Co.</i>					

Examine the foregoing account and answer the following questions:

- (a) Where did this take place?
- (b) When was each purchase made? What column shows this?
- (c) What was the nature of each purchase? How does the account show this?
- (d) Who purchased the goods? Where does the purchaser's name appear in the account?
- (e) Who sold the goods? Where is this shown?
- (f) What did the whole cost? Where is this shown?
- (g) What is the meaning of *received payment*?
- (h) Why is the name of the seller attached to this?

6. Make out bills for the following accounts and receipt them:

(a) February 1st, 1904, William Wallace bought of James Robinson, London, — 16 lb. tea at 45 ct., 17 lb. coffee at 40 ct., 18 lb. raisins at 10 ct. February 8th — 9 lb. of currants at 12 ct., 3 gal. coal oil at 35 ct. February 15th — 3 chickens at 40 ct. each, 4 doz. oranges at 25 ct. February 23d — 18 lb.

butter at 24 ct. February 29th — 6 lb. of oatmeal at 15 ct. a sack of flour at 65 ct., and 3 pk. of potatoes at 25 ct. a peck. Bill receipted March 1st.

(b) March 1st, 1904, James O'Shea bought of John Jamieson & Co., Furniture Dealers, Ottawa, — 1 dining table \$11, $\frac{1}{2}$ doz. chairs at \$36 per dozen, 1 secretary at \$25, 1 sideboard at \$45, and 1 lamp at \$4.75. Bill receipted April 1st.

7.

Halifax, April 1st, 1904.

D. Fleming,

Bought of Jones & Co., Grocers.

March	2	10 lb. coffee @ 35 ct.	\$ 3	50		
		30 lb. butter @ 24 ct.	7	20		
		1 doz. oranges @ 20 ct.		20		
		25 lb. sugar @ 6 ct.	1	50	\$12	40
		<i>Cr.</i>				
March	17	By 4 bu. potatoes @ 60 ct.	2	40	2	40
		Balance due			\$10	00
		<i>Received payment,</i>				
		<i>April 2d, 1904.</i>				
		<i>Jones & Co.,</i>				
		<i>per J. Boyle.</i>				

(a) How does this differ from the account given in question 5?

(b) What does *per J. Boyle* mean?

(c) When was this account rendered (sent)?

(d) When was it paid?

(e) What should D. Fleming do with the receipted account and why?

8. Make out and receipt the following bills:

(a) March 16th, 1904—John Cook bought of John Murray, Vancouver, 22 lb. sugar at 8 ct.; 14 lb. butter at 22 ct.; 18 lb. cheese at 15 ct.; 15 lb. tea at 55 ct.; 14 lb. dried apples at 12 ct.; 12 lb. currants at 13 ct.; a box of soda biscuits at 25 ct. March 29th.—John Cook sold to John Murray, 18 lb. nails at 7 ct.; 1 hammer at 35 ct.; 1 handsaw at \$1.35. Bill receipted April 1st by Peter West, a clerk in the employ of John Murray.

(b) April 4th, 1904—Murdoch McKenzie bought of A. Shewan and Co., Hamilton, 18 yd. cotton at 12 ct.; 17 yd. dress goods at 85 ct.; 40 yd. lace at 35 ct.; 32 yd. muslin at 15 ct.; 3 pr. kid gloves at \$1.00; 24 yd. sheeting at 18 ct.; $\frac{1}{2}$ doz. handkerchiefs at \$3 a doz.; 2 silk ties at 75 ct.; and 2 doz. silk buttons at 25 ct. Murdoch McKenzie worked for A. Shewan and Co. 15 days at \$2.50 a day, and paid the balance in cash on May 1st. Make out this bill and receipt it.

SUGGESTION.—As this is a matter all the pupils will likely have to do with later, it is suggested that the teacher enlarge on this exercise by encouraging the class to make up imaginary transactions covering the farm, the dairy, blacksmith shop, shoe shop, dry goods store, hardware store, grocery, drug store, etc.

Exercise 40

1. Harry earned 75 ct. on Monday, 80 ct. on Tuesday, 60 ct. on Wednesday, \$1.20 on Thursday, 95 ct. on Friday, and 50 ct. on Saturday.

(a) How much did Harry earn all together?

(b) How many days was he working?

(c) How much did he earn per day?

NOTE.—\$1.80 is called the *aggregate*, or *sum*; 80 ct. is called the *average*. If Harry had earned the average each day, he would have received the same aggregate on Saturday evening.

2. What is the average of :

(a) 9, 12, and 15?

(c) 75, 150, and 800?

(b) 18, 24, and 54?

(d) \$10, \$9, and \$8?

3. Find the average of :

(a) 23, 36, 45, 89, and 32.

(b) 72, 96, 108, and 24.

(c) 90, 80, 70, 60, and 100.

(d) \$54, \$63, \$87, and \$96.

4. The number of children in 6 rooms is as follows: 56, 24, 32, 18, 27, and 41. Find the average per room.

5. A farmer sold 3 cows for \$27, \$35, and \$34 respectively. Find the average selling price of a cow.

6. Find the average length of :

(a) Three boards which are 4 ft. long, 5 ft. long, and 6 ft. long.

(b) Four boards which are 7 ft. long, 8 ft. long, 9 ft. long, and 6 ft. long.

(c) Five boards, 4 ft. long, 3 ft., 7 ft., 9 ft., and 2 ft. 10 in. long.

7. James rode his bicycle at the rate of 6 miles the first hour, 10 miles the second hour, 8 miles the third hour, and 12 miles the fourth hour. How far did he go and at what average speed?

8. If the attendance of pupils at a school is Monday 36, Tuesday 42, Wednesday 24, Thursday 27, and Friday 31, find (a) the aggregate attendance and (b) the average attendance for the week.

9. If 2 inches of snow fell in November, 3 inches in December, 4 inches in January, 2 inches in February, how much snow should fall in March to make an average of 3 inches of snow per month?

10. The board in Figure A is 6 inches wide at the end AB , and a foot wide at the end CD . What is its average width?

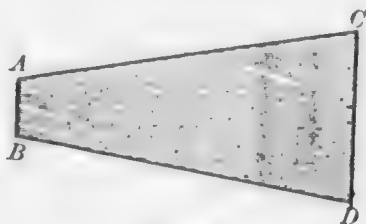


FIG. A

width? If the board is 12 ft. long, how many board feet are there in it? Thickness of board 1 inch. Prove result.

11. If a ditch is 6 ft. wide at the top and 4 ft. wide at the bottom, find its average width. Illustrate this by a diagram drawn to the scale of a quarter of an inch to the foot.

12. How many feet of lumber are there in :

(a) 20 2-inch planks 18 in. wide at one end, 9 in. at the other, and 15 ft. long?

(b) 36 3-inch planks 2 ft. wide at one end, 6 in. at the other, and 16 ft. long?

13. How many cubic feet of earth must be thrown out in order to dig a ditch :

(a) 4 ft. wide at top, 2 ft. wide at bottom, 3 ft. deep, and 60 ft. long?

(b) 7 ft. wide at top, 3 ft. wide at bottom, 5 ft. deep, and 80 yd. long?

14. Three fields each of 80 rods length have the following widths : 96 rods, 72 rods, and 60 rods. Find the total area of the three fields and show that three fields of the same length as the foregoing and of their average width will contain the same area.

15. A farmer sold 6 cows at \$36 each, 8 cows at \$42 each, and 4 cows at \$26 each. Find the average selling price of a cow.

16. A grocer mixed 15 lb. of 65 ct. tea, 18 lb. of 50 ct. tea, and 12 lb. of 60 ct. tea, and sold the mixture at 62 ct. per lb. Find his gain or loss.

17. The average of five numbers is 6000. Four of the numbers are respectively 2748, 6389, 7250, and 8175. Find the fifth number.

18. A farmer sold 13 loads of wheat from a 25-acre field. The first four loads each weighed 48 bu. 30 lb.; the next three, 56 bu. 40 lb.; the next four, 48 bu. and 15 lb., and the remaining loads, 41 bu. 30 lb. Find:

(a) The average weight of each load.

(b) The average yield per acre.

19. A grocer added 40 gallons of water to 260 gallons of vinegar which cost him 60 ct. per gallon. How much must he charge per gallon in order to gain \$30 on the whole?

SUGGESTION. — What had the grocer to pay for the water?

FACTORS, MEASURES, AND MULTIPLES

Exercise 41

1. Write down all the numbers between 1 and 31. Draw the pencil through those which are exactly divisible by 2. These are what we call *even* numbers; the remaining numbers are said to be *odd*.

2. Which of the following are even: 37, 54, 97, 86, 125, 131, 150, 162, 173, 288? How can you tell an even number? Mention two ways. How can you tell an odd number? Mention two ways.

3. Draw your pencil through all the odd numbers in the following: 8761, 9432, 8643, 24,644, 72,000, 86,745, 92,309, 22,2426, 36,638, 42,8317.

4. Find:

(a) The sum of all the odd numbers between 4206 and 4215.

(b) The sum of all the even numbers between 3999 and 4010.

5. What different pairs of numbers multiplied together make 42? 63? 81? 60? 72? 96? 35? 45? 24? 100? 91? These are called *factors* or *measures* of 42, 63, etc.

6. Five is a factor of ——. Seven is a factor of ——. Nine is a factor of ——. Eight is a factor of ——. What is a factor or measure of a number? Is 7 a factor of 15?

7. To find the smallest factors of 72. For small numbers the usual form is $72 = 2 \times 2 \times 2 \times 3 \times 3$. We know that 2 is a factor of 72 because 72 is an even number. The other factor is 36 which has also a 2 as a factor, 18 has a third 2, and 9 has 3 and 3. Or we can think of 72 as made up of 9 and 8. 9 has 3 and 3 as its factors and 8 has $2 \times 2 \times 2$ as its factors. Therefore 72 has $2 \times 2 \times 2 \times 3 \times 3$ as its simplest factors.

8. Find the smallest factors of: 24, 27, 30, 32, 38, 40, 42, 44, 45, 48, 49, 50, 52, 56, 60, 63, 64, 65, 69, 70, 75, 77, 80, 81, 84, 85, 88, 90, 91, 93, 95, and 96.

NOTE. — The smallest factors of a number are called *prime* factors. All numbers capable of being broken into factors are said to be *composite*. Those not capable of such division we call *prime*.

9. Draw the pencil through all the prime numbers in the following list: 31, 34, 37, 51, 53, 57, 59, 61, 67, 68, 71, 101.

10. Which of the following numbers are divisible by 5: 30, 35, 37, 50, 75, 83, 95, 120, 134, 175, and 190? How do you tell when 5 is a factor of any number?

11. Which of the following numbers are divisible by 4: 236, 728, 819, 820, 1648, 1727, 956, 42,832, and 16,403? Examine all the numbers in this list not divisible by 4. Look at the last two figures in each. Will 4 divide these exactly? Now take a look at the two figures ending the 728, 820, 1648, 956, and 42,832. Are these divisible by 4? If you wished to know whether any number was or was not divisible by 4 what would you do?

12. Which of these numbers is divisible by 8: 4736, 7888, 9742, 86,432, 200,936, 446,008, 72,840, and 5,324,872? Examine in this list the numbers not divisible by 8. Will 8 exactly divide the 742 of the 9742? Will it divide the 736 of the 4736, and the 936 of the 200,936? How can you tell when any number is exactly divisible by 8?

13. Will the devices given in 11 and 12 help you in the cases of 8000, 72,000, 9,600,000, and all numbers ending with 3 or more zeros?

14. To find the prime factors of 396. A common method is the following:

$$\begin{array}{r} 2 \overline{) 396} \\ \underline{2 \ 198} \\ 3 \ \overline{) 99} \\ \underline{3 \ 33} \\ 11 \end{array}$$

$396 = 2 \times 2 \times 3 \times 3 \times 11$, or $2^2 \times 3^2 \times 11$. The last arrangement is frequently used. It represents the factors in a shortened form. What do the small twos placed above and to the right of the larger 2 and 3 mean?

15. Which of the following are exactly divisible by 3: 76, 102, 611, 720, 803, 827, 1728, 400, 56,736, 722,463, and 422,460?

SUGGESTION.— Add the digits in each number and divide the sum by 3. If the division is exact then 3 is a factor.

16. Which of the following numbers are divisible by 9: 800, 927, 1017, 333,666, 811,890, 700,002, and 41,362?

SUGGESTION. — Apply a similar device to that of question 15

17. Which of the following are divisible by either 3, 4, 5, 8, or 9: 63,972, 213,231, 70,024, 1132, 7205, 4264, and 80,001?

18. Can you tell when a number is divisible by 6 without dividing the number?

19. Find the prime factors of:

(a)	(b)	(c)	(d)	(e)
143	495	512	1728	3150
385	702	729	5280	8064
168	968	4096	1760	1782
756	625	2000	1089	2730

SUGGESTION. — The student should use any of the helps given above in determining factors.

20. Find by removing factors the quotients of:

$720 \div 48$	$4080 \div 120$	$1980 \div 33$
$1680 \div 42$	$945 \div 63$	$11,088 \div 154$

NOTE. — In cases of exact division a number may be divided by another by removing all the factors of the latter from the factors of the former.

For example 216 has for its factors $2 \times 2 \times 2 \times 3 \times 3 \times 3$.

36 has for its factors $2 \times 2 \times 3 \times 3$.

Therefore $216 \div 36 =$ the factors remaining after the factors of 36 are removed from the factors of $216 = 2 \times 3 = 6$.

Exercise 42

1. Write in parallel lines the prime factors of 72 and 63. What factors are the same in each line? These are called the *common factors*, or *common measures*, of 72 and 63.

2. Find, as in question 1, the common factors of:

45 and 72	72 and 162	720 and 960	396 and 928
132 and 165	72 and 480	54 and 258	714 and 798
45 and 81	216 and 258	616 and 1518	2790 and 3330

3. Find what factors are common to:

15, 25, and 50	21, 28, and 35	54, 81, and 108
18, 27, and 36	56, 63, and 70	48, 60, and 120

4. The prime factors common to 105 and 165 are 3 and

5. The greatest exact divisor 105 and 165 can have must be the number of which 3 and 5 are the prime factors. What is this number? 15 is therefore the *highest common factor*, or *greatest common measure* (H. C. F. or G. C. M.) of 105 and 165. What is meant by the highest common factor of two or more numbers?

5. How do you find the highest common factor of two or more numbers? Question 4 will help you to answer this.

6. Find the highest common factor of:

45 and 72	72 and 162	720 and 960	18, 27, and 36
132 and 165	72 and 480	54 and 258	56, 63, and 70
45 and 81	216 and 258	616 and 1518	48, 60, and 120

The following form is the one commonly used for the smaller numbers:

Ex. To find the H. C. F. of 936 and 2925.

The prime factors of 936 are: $2 \times 2 \times 2 \times 3 \times 3 \times 13$.

The prime factors of 2925 are: $5 \times 5 \times 3 \times 3 \times 13$.

The common factors are 3, 3, and 13.

The H. C. F. is $3 \times 3 \times 13$ or 117.

7. Will a foot rule measure a board a yard long? Will it measure a board 7 feet long? Will it measure a board as long as the two mentioned? Will it measure a board whose length is equal to the difference between a five-foot board and a board a yard long?

8. If the flowers in each of two baskets are tied up in bunches of, say, 21 flowers each, can the total number of flowers in the two baskets be represented by bunches of 21 flowers each? Can the difference between the two baskets be represented by bunches of 21 flowers each?

9. If any number, say 15, measures each of two numbers, say 45 and 75, will it measure their sum? Will it measure their difference?

10. Will the H. C. F. of 42 and 56 measure the difference of these numbers? What is their difference? If the H. C. F. of 42 and 56 measures 14, 14 must contain that H. C. F. May 14 itself be the H. C. F.? How do you find whether it is or is not? This is another method of reaching the H. C. F. of two or more numbers. It is used when the numbers are about the same size and the factors cannot be reached readily by the simpler methods.

11. To find the H. C. F. of 2691 and 2717.

The difference is 26.

26 is not a factor because both numbers are odd.

The factors of 26 are 2 and 13; 2 is not a factor.

Therefore 13 must be the H. C. F. If not, there is no H. C. F.

Dividing 2691 by 13 we get 207.

Dividing 2717 by 13 we get 209.

Therefore 13 is the H. C. F.

12. Find by the method used in question 11 the H. C. F.
of : 1691 and 1767 2201 and 2449
 1541 and 1679 1591 and 2183

13. If any number, say 19, measures another, say 38, will 19 measure twice 38? 5 times 38? 9 times 38? Any number of times 38?

14. If 19 measures two numbers, say 38 and 95, will it measure their sum? (See question 9.) Will it measure

their difference? Will it measure 2 times 38 added to 3 times 95? Will it measure 2 times 38 taken from 3 times 95? Will it measure 13 times 38 added to 29 times 95? Will it measure 13 times 38 taken away from 29 times 95?

15. To find the H. C. F. of 936 and 2925.

From what we discovered in question 14, the H. C. F. of 936 and 2925 is contained in the difference between 2925 and 3 times 936. This difference is 117.

The factors of 117 are $3 \times 3 \times 13$. The H. C. F. is therefore either 3, 13, 9, 39, or 117. Trying 117 we find that it divides both 936 and 2925 exactly. It is therefore their H. C. F.

NOTE. — We multiplied 936 by 3 to obtain a number as near to 2925 as possible. Sometimes the number we wish is above the larger number, but the difference is still just as valuable.

16. Find by using the principle of question 15 the H. C. F. of:

1380 and 3328 994 and 3132 1702 and 8214

17. The most common method takes the following form :

Ex. To find the H. C. F. of 64,515 and 26,741.

$$\begin{array}{r}
 26741 \overline{)64515} (2 \\
 \underline{53482} \\
 11033 \overline{)26741} (2 \\
 \underline{22066} \\
 4675 \overline{)11033} (2 \\
 \underline{9350} \\
 1683 \overline{)4675} (2 \\
 \underline{3366} \\
 1309 \overline{)1683} (1 \\
 \underline{1309} \\
 374 \overline{)1309} (3 \\
 \underline{1122} \\
 \text{H. C. F.} = 187 \overline{)374} (2 \\
 \underline{374}
 \end{array}$$

18. Find by the common method the H. C. F. of:

1645 and	1833	1261 and	1649
1589 and	2724	1989 and	2873
1363 and	1739	1945 and	3501
8903 and	13,201	8903 and	10,991

Exercise 43

1. Find the length of the longest rule that will exactly measure a cord 39 ft. long, a fence 91 ft. long, and a sidewalk 143 ft. long.
2. A man has boards 18 ft. long, and boards 12 ft. long which he wishes to cut into boards of equal length. What is the greatest length into which the boards can be cut?
3. A farmer wishes to put 728 bushels of oats and 910 bushels of wheat into bins of the same size. Find the capacity of the largest bin that may be used without mixing the grains.
4. A farmer has two farms of 490 and 630 acres respectively, which he wishes to divide into fields of the same size. Find how many acres would be in the largest field he could arrange to have.
5. I own two lots fronting the same street. The width of the lots is 876 ft. and 1095 ft. respectively. If these lots are cut into lots of equal width, the widest possible, what will each be worth at \$7 per foot frontage?
6. How many posts will it take to fence a lot 675 ft. long and 432 ft. wide, the posts being placed the greatest possible distance apart?
7. Two loads of butter weighing 1379 lb. and 2401 lb. respectively are each to be made into rolls of the same weight. Find what must be the greatest weight of each roll.
8. How many boards will enclose a field 1320 ft. long by 1001 ft. wide, provided the fence is straight and 6 boards high, and the boards the longest that can be used?

Exercise 44

1. Give four numbers which have 7 as a factor. How did you get these? Is there any other way?

2. Give four numbers which have 9 as a factor. How were these obtained?

3. The numbers found in question 1 are said to be *multiples* of 7. Those found in the second question are called multiples of 9. What do you understand by a multiple of a number?

4. 35, 40, 60, 90, and 25 are multiples of what number? 15, 21, 27, and 33 are multiples of what number?

5. Find two multiples of each of the following numbers: 8, 11, 13, 23, 79, 121, and 327. How many multiples may any number have?

6. 256 is a multiple of what number? 625? 729? 1728?

7. What is the greatest multiple of 3 that can be expressed by two figures? Of 5? Of 7?

8. What is the greatest multiple of 12 that can be expressed by three figures? Of 15? Of 27?

9. Of what numbers are 2 and 3 factors? 6 and 8? 7 and 9? 12 and 15? 18 and 21? These are called *common multiples* of 2 and 3; 6 and 8; 7 and 9, etc.

10. Find common multiples of:

8 and 12	18 and 21	25 and 30	12 and 16
12 and 15	21 and 24	20 and 30	16 and 24
15 and 18	24 and 27	40 and 50	24 and 28

11. What is the least number of which 3, 5, and 7 are factors? Of which 4, 5, and 9 are factors? Of which 4 and 6 are factors? These are called the *least common multiples* (L. C. M.) of 3, 5, and 7, etc.

12. Find the L. C. M. of : 3, 4, and 5; 4, 5, and 7; 8 and 9; 7 and 12.

13. The factors of a number are $2 \times 2 \times 3 \times 3 \times 3 \times 7 \times 11$. Find the number. How many times does it contain 2 as a factor? 3 as a factor? 7 as a factor? 11 as a factor?

14. The prime factors of 72 are $2 \times 2 \times 2 \times 3 \times 3$

The prime factors of 108 are $2 \times 2 \times 3 \times 3 \times 3$.

(a) How often at least must the common multiple of 72 and 108 contain 2 as a factor?

(b) How often at least must it contain 3 as a factor?

(c) What number is the product of the factors mentioned in (a) and (b)?

(d) Is this the L. C. M. of 72 and 108?

15. To find the L. C. M. of 18, 24, 27, and 45.

The prime factors of 18 are $2 \times 3 \times 3$.

The prime factors of 24 are $2 \times 2 \times 2 \times 3$.

The prime factors of 27 are $3 \times 3 \times 3$.

The prime factors of 45 are $3 \times 3 \times 5$.

The L. C. M. of these numbers is therefore $2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 5$, or 1080. For the L. C. M. must contain the factors 2, 3, and 5. There must be three factors 2 since they occur in 24; there must again be three factors 3 since they occur in 27. There must also be a factor 5 since this is found in 45. 1080 contains these factors and no more. It is, therefore, the L. C. M. of 18, 24, 27, and 45.

16. Find by factoring the L. C. M. of :

12, 18, and 20	160 and 240	30, 35, and 40
16, 28, and 84	272 and 425	36, 42, and 54
14, 18, and 20	176 and 800	32, 56, and 80

17. Another form for showing the factors is the following :

Ex. To find the L. C. M. of 24, 42, 60, and 81.

2	24	42	60	81
2	12	21	30	81
3	6	21	15	81
	2	7	5	27

The L. C. M. is $2 \times 2 \times 3 \times 2 \times 7 \times 5 \times 27 = 22,680$.

(a) Show that the L. C. M. is divisible by 24.

(b) Show that it is divisible by 42, 60, and 81.

18. Find the L. C. M., using the form of question 17, of :

9, 12, and 21	18, 36, 45, and 81
15, 45, 75, and 90	12, 32, 48, and 72
25, 120, 15, and 84	16, 28, 35, and 63
18, 56, 50, and 72	32, 48, 14, and 40
44, 48, 52, and 96	15, 21, 28, and 35
12, 22, 55, and 40	12, 18, 27, 30, and 63

19. What is the H. C. F. of 48 and 63? Divide 48 by this H. C. F. What is the quotient? Divide 63 by the H. C. F. What is the quotient? Take the product of the H. C. F. and the two quotients. This is the L. C. M. of 48 and 63. Verify it. It is a method made use of when the numbers are not readily factored.

20. Find by the method of question 19 the L. C. M. of :

2041 and 8476	1955 and 2001
7409 and 4619	2501 and 8651

Exercise 45

1. Find the L. C. M. of all the numbers from 20 to 30 inclusive.

2. What is the least number which can be exactly divided by:

(a) 3, 4, and 5?

(c) 7, 8, and 10?

(b) 8 and 9?

(d) 12, 15, and 13?

3. What is the smallest sum of money which can be paid in either 5-dollar bills, 4-dollar bills, or 20-dollar bills?

4. One boy can wheel 60 miles in a day, a second can wheel 48 miles in a day, and a third 54 miles in a day. Find the least distance which would furnish each of them a full number of days of wheeling.

5. How many times is the H. C. F. of 48, 36, 72, and 60 contained in their L. C. M.?

6. Find the least number which will leave a remainder 3 when divided by 5, 7, and 11.

7. Find the least number which, when divided by 33, 171, and 1900, will always leave the same remainder, 23.

8. Find the prime factors of 2520.

9. If a man takes a step of 36 inches, a woman a step of 24 inches, and a boy a step of 18 inches, how often will all three step together in walking 5 miles, supposing they start together?

10. How many acres of land would admit of being divided into farms containing 150, 200, or 240 acres each?

11. What do you mean by saying that two numbers are prime to each other? When two numbers are prime to each other may they both be composite?

12. The product of three consecutive (following each other, like 17, 18, 19) numbers is 2184. Find the numbers.

13. What is the smallest amount of money for which I could purchase pigs at \$8 each, sheep at \$6, or cows at \$35 each?

L.P.

14. What is the length of the longest stick that will exactly measure 6 yards, 4 yards, and 18 inches?

15. What is the average age of five men who are 79, 80, 78, 83, and 75 years old respectively?

16. The population of three towns is 19,375, 24,125, and 16,000 respectively. What is the average population of the towns?

17. A train travels 15 miles the first hour, 20 the second, and 21 the third. Find the average distance which it travels per hour.

18. A merchant bought 50 dozen bottles of wine at \$10.50 per doz.; 40 dozen bottles at \$5.25 per doz., and 81 doz. bottles at \$3 per doz. Find the average cost per dozen.

19. A retired farmer rents 100 acres at \$5 per acre, 150 acres at \$6 per acre, and 200 acres at \$6.50 per acre. What average rent does he receive per acre?

20. In a certain factory 10 men receive \$10 per week, 4 times as many receive \$9 per week, and 10 times as many receive \$5 per week. Find the average weekly wages of each man.

21. Make out the following account, render it on March 1st, and receipt it on March 3d:

Robert Hall bought of Archibald Wright, 16 yd. silk at \$3.25, 6 pairs of hose at 60 ct., 2 pairs of gloves at \$1.35, and 35 yd. dress goods at 85 ct.

FRACTIONS

Exercise 46 (Introductory Review)

1. What part of:

(a) 24 is 18? (b) 27 is 18? (c) 36 is 18?

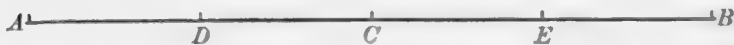
2. What fraction of:

(a) 30 is 20? (b) 28 is 14? (c) 42 is 12?

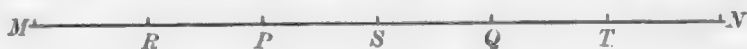
3. What is the ratio of :
 - (a) A pint to a gallon?
 - (b) \$15 to \$20?
4. (a) $\frac{3}{4}$ of 20 is what part or fraction of 25?
 (b) $\frac{2}{5}$ of 15 is what part or fraction of 18?
5. Find the sum of :
 - (a) $\frac{2}{3}$ of 12 + $\frac{3}{8}$ of 24 + $\frac{5}{7}$ of 21 and $\frac{3}{6}$ of 18.
 - (b) $\frac{4}{7}$ of 28 + $\frac{3}{5}$ of 30 + $\frac{5}{6}$ of 24 and $\frac{7}{9}$ of 36.
6. Find the difference between :
 - (a) $\frac{5}{6}$ of 42 and $\frac{2}{3}$ of 21.
 - (b) $\frac{6}{7}$ of 35 and $\frac{3}{4}$ of 20.
7. Find the product of :
 - (a) $\frac{4}{7}$ of 21 and $\frac{5}{6}$ of 18.
 - (b) $\frac{3}{5}$ of 24 and $\frac{5}{9}$ of 45.
8. Divide :
 - (a) $\frac{7}{9}$ of 63 by 7.
 - (b) $\frac{5}{8}$ of 56 by 5.
 - (c) $1\frac{1}{2}$ of 72 by 3.
9. Find :
 - (a) How many hours there are in $\frac{3}{4}$ of a day. In $\frac{5}{6}$ of a day.
 - (b) What part of a day is 18 hr. 20 hr. 22 hr.
 - (c) How many months there are in $\frac{5}{6}$ yr. $\frac{2}{3}$ yr. $1\frac{1}{2}$ yr.
 - (d) What part of a year is 9 mo. 12 mo. 18 mo.
 - (e) What part of an hour is 40'. 35'. 70'. 90'.
10. Six envelopes contain the following sums of money : \$1, \$2, \$3, \$12, \$17, and \$24. Find the total sum.
11. James divided \$40 as follows : to William he gave $\frac{1}{4}$ of \$36; to John $\frac{2}{3}$ of 24 dollars; he kept the remainder himself. How much money has he? What part of all his money has he?
12. Tom and Harry put their money together and purchased 42 marbles. How should the marbles be divided, provided Harry put in $\frac{2}{7}$ of the money? If on a division Tom had 14 marbles as his share, what part of the money must he have had?

Exercise 47

1. Show that $\frac{1}{2}$ the line AB is equal to $\frac{2}{4}$ of the same line.



2. Show that the half of MN is the same as $\frac{3}{6}$ of MN .



3. Show from the accompanying rectangle that $\frac{3}{8}$ of a number or thing is the same as $\frac{6}{16}$ of that number or thing:



4. Show by referring to each of the numbers 36, 48, and 60 that $\frac{5}{6}$ is the same as $\frac{10}{12}$.

5. Verify, by referring to a straight line, a surface, and a number, that:

(a) $\frac{5}{8}$ of a thing is the same as $\frac{10}{16}$ of it.

(b) $\frac{4}{7}$ of anything is the same as $\frac{8}{14}$ of it.

(c) $\frac{3}{5}$ of a number or thing is the same as $\frac{6}{10}$ of it.

6. Write the following fractions: three-eighths, seven-ninths, eighteen-twentieths, and seventy-five one hundredths.

7. Read these fractions: $\frac{17}{20}$, $\frac{13}{15}$, $\frac{12}{18}$, $\frac{3}{19}$, and $\frac{20}{30}$.

8. What figure in the fraction $\frac{5}{8}$ shows how many equal parts the number, or thing, has been divided into? This is called the *denominator* of the fraction. What does the other figure of the fraction $\frac{5}{8}$ show? It is called the *numerator* of the fraction, and both the numerator and the denominator of a fraction are spoken of as the *terms*.

9. Name the numerators and denominators in $\frac{7}{15}$, $\frac{8}{9}$, and $\frac{18}{21}$.

10. $\frac{5}{8} = \frac{10}{16} = \frac{15}{24} = \frac{20}{32} = \text{etc.}$

(a) Examine the numerators of these equal fractions. How can you get the second numerator from the first? The third from the first? The fifth from the first?

(b) Compare now the denominators, as in (a). How can you get the second from the first? the fourth from the first? the seventh from the first?

(c) Putting (a) and (b) together, state what effect multiplying the numerator and denominator by the same number has on the value of a fraction.

11. Using (c) of question 10, write several fractions equivalent to $\frac{3}{5}$, $\frac{7}{8}$, $\frac{5}{6}$, and $\frac{6}{7}$.

12. If $\frac{5}{8} = \frac{10}{16} = \frac{15}{24} = \frac{20}{32} = \text{etc.}$, what will be the effect on the value of the fraction of:

(a) Dividing the terms of $\frac{20}{32}$ by 4?

(b) Dividing the terms of $\frac{15}{24}$ by 3?

(c) Dividing the terms of $\frac{10}{16}$ by 2?

(d) Dividing the terms of any fraction by the same number?

13. Using (d) of question 12, write fractions of lower terms than, but equivalent to, the following: $\frac{24}{42}$, $\frac{36}{42}$, $\frac{35}{70}$, $\frac{27}{81}$, $\frac{42}{54}$, $\frac{72}{96}$.

NOTE.—If we multiply or divide the terms of any fraction by the same number, the value of the fraction remains unchanged.

14. (a) What must you multiply the terms of $\frac{5}{7}$ by to get the fraction $\frac{45}{63}$?

(b) What must you multiply the terms of $\frac{3}{4}$ by to get the fraction $\frac{75}{100}$?

(c) What must you divide the terms of $\frac{42}{60}$ by to get the fraction $\frac{7}{10}$?

(d) What must you divide the terms of $\frac{36}{54}$ by to get the fraction $\frac{2}{3}$?

15. Divide $3 \times 5 \times 7 \times 8$ by $6 \times 15 \times 24$.

SOLUTION. — $(3 \times 5 \times 7 \times 8) \div (6 \times 15 \times 24)$ is equal to $\frac{3 \times 5 \times 7 \times 8}{6 \times 15 \times 24}$ since this form indicates a division.

NOTE. — When the product of a number of factors is to be divided by the product of another number of factors, the division may be represented in the form of a fraction. Equal factors may then be removed from the terms. The factors remaining in the numerator when multiplied together give the numerator of the equivalent fraction, and the factors remaining in the denominator when multiplied together give the denominator of the equivalent fraction. This process we call *cancellation*.

$$\text{Therefore, } \frac{3 \times 5 \times 7 \times 8}{6 \times 15 \times 24} = \frac{\cancel{3} \times \cancel{5} \times \cancel{7} \times \cancel{8}}{\cancel{2} \times \cancel{3} \times \cancel{2} \times \cancel{3} \times \cancel{2} \times \cancel{4}} = \frac{7}{18}.$$

16. Reduce (change) the following fractions to their lowest (smallest) terms by removing the equal factors of the numerator and denominator, as in 15:

(a)	(b)	(c)	(d)	(e)	(f)	(g)
$\frac{32}{36}$	$\frac{24}{56}$	$\frac{120}{360}$	$\frac{186}{208}$	$\frac{630}{900}$	$\frac{204}{268}$	$\frac{650}{910}$
$\frac{48}{72}$	$\frac{39}{69}$	$\frac{300}{400}$	$\frac{125}{375}$	$\frac{200}{225}$	$\frac{140}{210}$	$\frac{750}{1000}$
$\frac{81}{99}$	$\frac{125}{425}$	$\frac{160}{240}$	$\frac{640}{800}$	$\frac{175}{350}$	$\frac{600}{840}$	$\frac{99}{830}$

NOTE. — When we wish to reduce a fraction to its lowest terms we usually take advantage of the following device:

$$\frac{1}{12} = \frac{120}{240} = \frac{1}{2}$$

17. Reduce the following fractions to their lowest terms, using the form given in the note under question 16:

$\frac{2}{4}$	$\frac{7}{21}$	$\frac{18}{30}$	$\frac{20}{25}$	$\frac{27}{63}$	$\frac{60}{100}$	$\frac{32}{36}$
$\frac{6}{24}$	$\frac{14}{21}$	$\frac{24}{32}$	$\frac{25}{35}$	$\frac{26}{91}$	$\frac{77}{84}$	$\frac{50}{80}$
$\frac{12}{28}$	$\frac{28}{35}$	$\frac{18}{48}$	$\frac{35}{40}$	$\frac{19}{57}$	$\frac{33}{55}$	$\frac{24}{24}$

Exercise 48

1. Divide by cancellation :

(a) $7 \times 9 \times 12 \times 15$ by $8 \times 15 \times 18 \times 14$.

(b) $12 \times 14 \times 25$ by $24 \times 35 \times 28$.

(c) $9 \times 15 \times 18$ by $12 \times 24 \times 30$.

2. How many yards of tweed at 72 ct. a yard can be purchased with 28 bushels of potatoes at 36 ct. a bushel?

SOLUTION. — 28 bu. potatoes are worth 36×28 ct.

$$\text{At 72 ct. per yard this will purchase } \frac{36 \times 28}{72} \text{ yd., or 14 yd., Ans.}$$

3. How many pounds of tea :

(a) At 48 ct. can be bought with 25 bu. of wheat at 90 ct.?

(b) At 60 ct. can be bought with 90 bu. of wheat at 80 ct.?

(c) At 55 ct. can be bought with 60 doz. eggs at 22 ct.?

4. How many bushels of potatoes at 56 ct. can be given in exchange for 35 bu. of barley at 48 ct. a bushel?

5. 7 farms each containing 35 acres, at \$40 an acre, were exchanged for 98 horses. Find the value of a horse.

6. A potato field contains 240 rows, each row 720 hills, and each hill 12 potatoes. If 8 potatoes fill a quart, find how many bushels of potatoes can be gathered.

7. A merchant tailor bought 18 pieces of cloth, each containing 24 yd., worth \$3.75 a yard. He made this into 54 suits. How much did he ask per suit so as to come out without any loss?

8. How many:

(a) Tons of hay @ \$12 will pay for 4 bbl. sugar (232 lb.) @ 9 ct. a pound?

(b) Horses @ \$84 will pay for 12 acres of land @ \$140 an acre?

(c) Tubs of butter (56 lb.) @ 28 ct. will pay for 198 yd of muslin at 32 ct.?

(d) Bushels of potatoes @ 75 ct. will pay for 225 gal. of oil at 45 ct.?

9. At what price will:

(a) 35 lb. of tea pay for 140 bu. of wheat at 67 ct.?

(b) 65 acres of land pay for 91 horses at 125 dollars each?

(c) 108 lb. of cheese pay for 36 doz. oranges at 45 ct. a dozen?

(d) 72 bu. of potatoes pay for 180 yd. of lace at 24 ct. a yard?

ADDITION OF FRACTIONS

Exercise 49

1. Add:

(a) $\frac{3}{8} + \frac{2}{8} + \frac{1}{8}$. (b) $\frac{2}{7} + \frac{3}{7} + \frac{1}{7}$. (c) $\frac{3}{15} + \frac{2}{15} + \frac{4}{15} + \frac{1}{15}$.

2. Add:

(a) 2 yd. + 4 ft. + 13 in.

(b) 3 gal. + 2 qt. + 1 pt.

(c) 4 lb. + 3 oz.

3. Make these fractions similar:

NOTE. — *Similar* fractions are those having the same denominator.

(a) $\frac{1}{2}$, $\frac{3}{10}$, $\frac{1}{5}$.

(d) $\frac{1}{2}$, $\frac{2}{5}$, $\frac{3}{4}$.

(g) $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$.

(b) $\frac{1}{3}$, $\frac{5}{6}$, $\frac{4}{5}$.

(e) $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$.

(h) $\frac{1}{8}$, $\frac{2}{5}$, $\frac{1}{3}$.

(c) $\frac{1}{3}$, $\frac{5}{6}$, $\frac{3}{8}$.

(f) $\frac{2}{5}$, $\frac{1}{10}$, $\frac{1}{8}$.

(i) $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$.

SUGGESTION. — Take a look at the denominators of (a). They are 2, 10, and 5. Ask yourself: What is the least number that will contain either of these? In this case it is 10. Now, change $\frac{1}{2}$ to tenths, viz.: $\frac{5}{10}$; $\frac{3}{10}$ is right as it stands; $\frac{1}{5}$ is $\frac{2}{10}$. Deal in a similar manner with the remainder.

4. Add:

$$\begin{array}{llll}
 (a) \frac{1}{2} + \frac{2}{5} & (d) \frac{4}{5} + \frac{5}{6} & (g) \frac{1}{2} + \frac{5}{6} & (j) \frac{1}{2} + \frac{4}{5} \\
 (b) \frac{2}{5} + \frac{7}{10} & (e) \frac{1}{5} + \frac{5}{6} & (h) \frac{5}{6} + \frac{2}{3} & (k) \frac{1}{2} + \frac{5}{12} \\
 (c) \frac{1}{3} + \frac{5}{6} & (f) \frac{2}{3} + \frac{3}{4} & (i) \frac{5}{8} + \frac{1}{5} & (l) \frac{3}{4} + \frac{5}{12}
 \end{array}$$

5. Which is the greatest and which the least of the following pairs of fractions:

$$(a) \frac{2}{3} \text{ or } \frac{5}{6} \quad (b) \frac{3}{4} \text{ or } \frac{5}{8} \quad (c) \frac{5}{6} \text{ or } \frac{5}{8} \quad (d) \frac{3}{4} \text{ or } \frac{4}{5} \quad (e) \frac{2}{3} \text{ or } \frac{7}{12}$$

6. Add:

$$\begin{array}{lll}
 (a) \frac{3}{4} + \frac{2}{3} + \frac{5}{6} & (c) \frac{1}{3} + \frac{5}{9} + \frac{5}{6} & (e) \frac{2}{3} + \frac{3}{4} + \frac{1}{2} \\
 (b) \frac{2}{3} + \frac{4}{5} + \frac{1}{15} & (d) \frac{1}{2} + \frac{3}{10} + \frac{2}{5} & (f) \frac{2}{5} + \frac{5}{6} + \frac{3}{8}
 \end{array}$$

7. Read $6\frac{1}{2}$, $7\frac{1}{3}$, $2\frac{3}{4}$, $4\frac{5}{6}$, and $7\frac{3}{8}$.

8. Add:

$$\begin{array}{ll}
 (a) 3\frac{1}{2} + 4\frac{3}{4} + 2\frac{1}{3} & (c) 5\frac{3}{8} + 4\frac{1}{4} \\
 (b) 4\frac{2}{5} + 7\frac{3}{8} & (d) 6\frac{2}{3} + 7\frac{1}{2}
 \end{array}$$

$$\begin{aligned}
 \text{Solution of (a):} \quad & 3\frac{1}{2} + 4\frac{3}{4} + 2\frac{1}{3} \\
 &= 3 + \frac{1}{2} + 4 + \frac{3}{4} + 2 + \frac{1}{3} \\
 &= (3 + 4 + 2) + (\frac{1}{2} + \frac{3}{4} + \frac{1}{3}) \\
 &= 14 + \frac{6}{12} + \frac{9}{12} + \frac{4}{12} \\
 &= 14 + \frac{19}{12} \\
 &= 14 + 1\frac{7}{12} \\
 &= 15\frac{7}{12} \text{ Ans.}
 \end{aligned}$$

9. Add:

(a)	(b)	(c)	(d)
346 $\frac{1}{2}$	\$964 $\frac{1}{3}$	721 $\frac{1}{4}$ in.	960 $\frac{1}{2}$ lb.
278 $\frac{3}{4}$	\$275 $\frac{5}{6}$	825 $\frac{3}{8}$ in.	728 $\frac{5}{6}$ lb.
875 $\frac{1}{8}$	\$848 $\frac{3}{12}$	460 $\frac{1}{2}$ in.	800 $\frac{3}{4}$ lb.

10. A grocer sold $\frac{1}{2}$ a dozen oranges to one man, $\frac{1}{3}$ of a dozen to a second, $\frac{5}{6}$ of a dozen to a third. He has still in stock $2\frac{1}{2}$ dozen oranges. How many dozen had he at first?

11. I sold $\frac{2}{5}$ of an acre to one person and $\frac{3}{5}$ of an acre to another. How much did I sell all together?

12. Tom can dig $\frac{1}{2}$ of a ditch in a day. Harry can dig $\frac{1}{3}$ of it in the same time. How much can both dig in a day?

13. If a boy had \$4 $\frac{1}{4}$ and earned \$2 $\frac{3}{8}$ more, how much money would he then have?

14. Mary spent $\frac{1}{5}$ of a dollar for a book, $\frac{1}{8}$ of a dollar for note paper and envelopes. If she had still $\frac{3}{4}$ of a dollar, how much had she at first?

15. A man travels 3 $\frac{1}{2}$ miles the first hour, 2 $\frac{1}{3}$ miles the second, and 3 miles the third. How far did he travel altogether?

16. What must you add to the sum of 2 $\frac{1}{3}$ and 3 $\frac{1}{4}$ to make the result a whole number?

17. Mr. Brown bought 3 loads of wood. In the first load there were $\frac{3}{4}$ of a cord, in the second $\frac{2}{3}$ of a cord, and in the third $\frac{5}{8}$ of a cord. Find how many cords of wood were bought.

18. How far is it around a lot 30 $\frac{2}{3}$ yd. long and 20 $\frac{2}{3}$ yd. wide?

19. A farmer sold 13 $\frac{1}{2}$ bu. of potatoes on Monday, 17 $\frac{3}{4}$ bus. on Tuesday, and 15 $\frac{5}{8}$ bu. on Wednesday. How much did he sell all together?

SUBTRACTION OF FRACTIONS

Exercise 50

1. From:

- | | | |
|--|---|---|
| (a) $\frac{3}{5}$ take $\frac{1}{2}$. | (d) $\frac{1}{5}$ take $\frac{1}{8}$. | (g) $\frac{2}{3}$ take $\frac{3}{8}$. |
| (b) $\frac{1}{3}$ take $\frac{1}{6}$. | (e) $\frac{7}{10}$ take $\frac{3}{8}$. | (h) $\frac{5}{6}$ take $\frac{3}{4}$. |
| (c) $\frac{5}{8}$ take $\frac{4}{5}$. | (f) $\frac{7}{8}$ take $\frac{3}{4}$. | (i) $\frac{9}{10}$ take $\frac{4}{5}$. |

2. From:

(a) $18\frac{5}{8}$ take $7\frac{2}{3}$.

(c) $75\frac{1}{4}$ take $13\frac{3}{16}$.

(b) $24\frac{3}{8}$ take $19\frac{7}{8}$.

(d) $87\frac{7}{8}$ take $15\frac{1}{8}$.

3. Write 1 as eighths, as sixths, as tenths, as fifths, and as thirds.

4. From:

(a) $20\frac{2}{3}$ take $5\frac{5}{8}$.

(c) $32\frac{3}{4}$ take $14\frac{1}{8}$.

(b) $17\frac{3}{8}$ take $9\frac{2}{3}$.

(d) $73\frac{1}{4}$ take $10\frac{1}{2}$.

SUGGESTION.— $20\frac{2}{3}$ is 19 and $1\frac{2}{3}$. This is 19 and $\frac{4}{3} + \frac{2}{3}$ or $19\frac{2}{3}$.

5. $\frac{1}{5}$ of the scholars in a certain school are in grade 5, and $\frac{2}{5}$ in grade 4. The remainder were in grades 1, 2, and 3. Find what part of the school are below grade 4.

6. Find the difference between:

(a) $\frac{5}{8}$ of my age and $\frac{2}{3}$ of my age.

(b) $\frac{7}{8}$ of my property and $\frac{3}{4}$ of my property.

7. How much have I left after paying:

(a) $\frac{3}{4}$ of a dollar out of $\frac{4}{5}$ of a dollar?

(b) $\frac{2}{3}$ of a dollar out of $\frac{9}{10}$ of a dollar?

8. What number must be added to the sum of $\frac{1}{8}$, $\frac{1}{5}$, and $\frac{1}{4}$ to make $\frac{3}{10}$?

9. Find the difference between:

(a) $14\frac{1}{2}$ inches and $10\frac{1}{4}$ inches.

(b) $7\frac{5}{8}$ yards and $3\frac{1}{8}$ yards.

(c) $9\frac{3}{8}$ bushels and $3\frac{3}{4}$ bushels.

10. Harry earned \$15 $\frac{3}{4}$. This was \$3 $\frac{2}{3}$ more than what Tom earned. How much did Tom earn?

11. From:

(a) The sum of $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{1}{2}$ take the sum of $\frac{4}{5}$ and $\frac{1}{2}$.

(b) The sum of $\frac{4}{5}$ and $\frac{5}{8}$ take the sum of $\frac{1}{2}$ and $\frac{1}{3}$.

(c) The sum of $\frac{3}{2}$ and $\frac{4}{3}$ take the difference between $\frac{1}{2}$ and $\frac{1}{3}$.

MULTIPLICATION OF FRACTIONS

Exercise 51

1. If an apple cost $\frac{1}{2}$ a cent, what will 4 apples cost? 6 apples? 12 apples? 22 apples? How did you get these results?

2. If a pound of tea cost $\frac{1}{4}$ of a dollar, what will 8 pounds cost? 12 pounds? 20 pounds? 24 pounds? 40 pounds?

3. If each of 8 boys has $\frac{3}{4}$ of a dollar, how much money have all?

4. Multiply:

(a) $\frac{2}{3}$ by 3, 6, and 12.

(d) $\frac{1}{4}$ by 9, 10, and 15.

(b) $\frac{3}{8}$ by 8, 20, and 24.

(e) $\frac{2}{7}$ by 7, 14, and 21.

(c) $\frac{1}{2}$ by 10, 16, and 20.

(f) $\frac{2}{3}$ by 3, 6, and 12.

5. Make a statement as to how you multiply a fraction by a whole number.

6. How much will 18 yards of cloth cost at $6\frac{1}{2}$ cents a yard? $8\frac{2}{3}$ cents? $10\frac{5}{8}$ cents? $14\frac{1}{3}$ cents?

7. Multiply:

(a) $12\frac{1}{2}$ by 6, 8, and 10.

(d) $25\frac{3}{4}$ by 4, 8, and 16.

(b) $16\frac{2}{3}$ by 6, 9, and 12.

(e) $8\frac{2}{3}$ by 3, 6, and 15.

(c) $33\frac{1}{3}$ by 3 and 6.

(f) $9\frac{5}{8}$ by 6, 12, and 30.

8. Find the cost of:

(a) $20\frac{1}{2}$ pounds of butter at 24 cents a pound.

(b) $16\frac{3}{4}$ yards of cloth at \$3 a yard.

(c) $240\frac{2}{3}$ pounds of sugar at 6 cents a pound.

9. Find the cost of:

(a) $\frac{7}{8}$ acres of land at \$64 an acre.

(b) $\frac{3}{4}$ yards of cloth at \$1.20 a yard.

(c) $\frac{5}{8}$ pounds of cheese at 12 cents a pound.

10. Multiply:

(a) 24 by $\frac{3}{4}$, $\frac{5}{8}$, $\frac{7}{8}$.

(d) 60 by $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{9}{10}$, $\frac{7}{12}$.

(b) 30 by $\frac{3}{8}$, $\frac{5}{6}$, $\frac{1}{16}$.

(e) 72 by $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{8}$, $\frac{7}{8}$, $\frac{9}{10}$, $\frac{7}{12}$.

(c) 42 by $\frac{5}{6}$, $\frac{7}{8}$.

(f) 100 by $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{7}{10}$, $\frac{8}{10}$, $\frac{9}{10}$.

SUGGESTION. — Read $24 \times \frac{3}{4}$ the same as $\frac{3}{4}$ of 24.

11. Multiply:

(a) 12 by $3\frac{1}{4}$.

(d) 25 by $3\frac{1}{6}$.

(g) 35 by $3\frac{2}{7}$.

(b) 18 by $7\frac{2}{3}$.

(e) 30 by $2\frac{3}{10}$.

(h) 36 by $4\frac{3}{8}$.

(c) 24 by $5\frac{5}{6}$.

(f) 32 by $7\frac{1}{5}$.

(i) 39 by $3\frac{1}{3}$.

12. Make:

(a) A rule for multiplying a fraction by a whole number.

(b) A rule for multiplying a whole number by a fraction.

13. Multiply:

(a) $\frac{2}{3}$ by 6.

(d) $\frac{7}{8}$ by 9.

(g) $\frac{3}{8}$ by 7.

(j) $2\frac{2}{3}$ by 3.

(b) $\frac{5}{6}$ by 7.

(e) $\frac{6}{7}$ by 8.

(h) $\frac{8}{9}$ by 3.

(k) $3\frac{3}{4}$ by 8.

(c) $\frac{3}{4}$ by 9.

(f) $\frac{4}{5}$ by 12.

(i) $\frac{2}{3}$ by 9.

(l) $4\frac{1}{5}$ by 9.

14. If berries cost 5 cents a quart, what part of a peck can be bought for a quarter?

15. If a grocer's profits are 25 cents of every dollar received, what part of what he receives is profit? How much will he make on \$20 sales? \$48 sales? \$120 sales?

16. If:

(a) 10 is $\frac{5}{6}$ of a number, find $3\frac{3}{4}$ times that number.

(b) \$8 is the value of $\frac{4}{5}$ of a ton of coal, what will $5\frac{1}{2}$ tons cost?

(c) $\frac{2}{3}$ of a pound of raisins cost 10 cents, what will $2\frac{2}{3}$ pounds cost?

17. What part of:

(a) $\frac{3}{4}$ is $\frac{1}{4}$?

(d) $\frac{9}{10}$ is $\frac{4}{5}$?

(b) $\frac{5}{6}$ is $\frac{1}{6}$?

(e) $\frac{9}{12}$ is $\frac{2}{3}$?

(c) $\frac{7}{8}$ is $\frac{3}{8}$?

(f) $\frac{12}{15}$ is $\frac{2}{5}$?

18. What is:

- (a) $\frac{3}{4}$ of 12? $\frac{2}{3}$ of 6? $\frac{4}{5}$ of 10? $\frac{5}{8}$ of 12?
 (b) $\frac{3}{4}$ of $\frac{8}{16}$? $\frac{2}{3}$ of $\frac{4}{6}$? $\frac{4}{5}$ of $\frac{10}{12}$? $\frac{5}{8}$ of $\frac{12}{16}$?
 (c) $\frac{3}{4}$ of $\frac{12}{15}$? $\frac{2}{3}$ of $\frac{10}{9}$? $\frac{4}{5}$ of $\frac{15}{18}$? $\frac{5}{8}$ of $\frac{24}{30}$?

19. What is:

- (a) $\frac{1}{2}$ of $\frac{3}{4}$? (d) $\frac{5}{6}$ of $\frac{2}{3}$? (g) $\frac{1}{3}$ of $\frac{3}{4}$? (j) $\frac{5}{6}$ of $\frac{1}{2}$?
 (b) $\frac{2}{3}$ of $\frac{4}{5}$? (e) $\frac{3}{4}$ of $\frac{2}{5}$? (h) $\frac{3}{4}$ of $\frac{1}{2}$? (k) $\frac{5}{6}$ of $\frac{7}{8}$?
 (c) $\frac{3}{4}$ of $\frac{5}{6}$? (f) $\frac{2}{3}$ of $\frac{5}{8}$? (i) $\frac{3}{5}$ of $\frac{3}{4}$? (l) $\frac{4}{5}$ of $\frac{5}{6}$?

SUGGESTION. — In (a) change $\frac{3}{4}$ to $\frac{6}{8}$. $\frac{1}{2}$ of $\frac{6}{8}$ is $\frac{3}{8}$.

20. (a) $\frac{1}{2}$ of $\frac{7}{8}$ is $\frac{7}{16}$. (c) $\frac{2}{3}$ of $\frac{4}{5} = \frac{8}{15}$.
 (b) $\frac{5}{6}$ of $\frac{7}{8} = \frac{35}{24}$. (d) $\frac{5}{6}$ of $\frac{7}{9} = \frac{35}{54}$.

In a, b, c, and d what is the relation of the numerator of the result to the numerators of the question? What is the relation of the denominators? Ascertain if the rule held good for question 19.

21. Using what you found in question 20, find the value of:

- (a) $\frac{3}{7}$ of $\frac{8}{9}$. (d) $\frac{4}{5}$ of $\frac{9}{12}$. (g) $\frac{3}{9}$ of $\frac{7}{12}$.
 (b) $\frac{5}{6}$ of $\frac{2}{3}$. (e) $\frac{7}{3}$ of $\frac{8}{5}$. (h) $\frac{4}{6}$ of $\frac{5}{8}$.
 (c) $\frac{4}{8}$ of $\frac{7}{12}$. (f) $\frac{8}{7}$ of $\frac{6}{8}$. (i) $\frac{3}{8}$ of $\frac{9}{12}$.

22. If:

- (a) $\frac{2}{3}$ of $\frac{4}{5}$ yd. cost 16 ct., what will 5 yd. cost?
 (b) $\frac{3}{4}$ of $\frac{5}{6}$ bushels of wheat cost 30 ct., what will 3 bushels cost?

23. Multiply:

- (a) $\frac{7}{8}$ by $\frac{4}{5}$. (d) $\frac{5}{8}$ by $\frac{3}{4}$. (g) $\frac{7}{8}$ by $\frac{3}{4}$.
 (b) $\frac{6}{7}$ by $\frac{2}{3}$. (e) $\frac{1}{2}$ by $\frac{7}{6}$. (h) $\frac{4}{5}$ by $\frac{7}{8}$.
 (c) $\frac{5}{9}$ by $\frac{5}{6}$. (f) $\frac{3}{10}$ by $\frac{4}{5}$. (i) $\frac{5}{8}$ by $\frac{5}{9}$.

SUGGESTION. — Read $\frac{2}{3} \times \frac{4}{5}$ as $\frac{2}{3}$ of $\frac{4}{5} = \frac{4 \times 2}{5 \times 3} = \frac{8}{15}$.

24. Find the cost of :

- (a) $\frac{4}{5}$ yd. of cloth at $\frac{3}{4}$ of a dollar a yard.
- (b) $\frac{7}{8}$ lb. of lard at $\frac{1}{6}$ of a dollar a pound.
- (c) $\frac{5}{6}$ bu. of onions at $\frac{4}{5}$ of a dollar a bushel.
- (d) $\frac{2}{3}$ yd. of lace at $\frac{2}{3}$ of a dollar a yard.

25. Multiply : $20 \times 4\frac{1}{2}$, $32 \times 3\frac{3}{4}$, $48 \times 2\frac{2}{3}$.

SOLUTION. — $16 \times 2\frac{1}{2} = 2$ times 16 and $\frac{1}{2}$ of 16.

$$\begin{array}{r} 16 \\ \underline{2\frac{1}{2}} \\ 32 \\ \underline{12} \\ 44 \end{array}$$

26. Find the cost of :

- (a) $7\frac{3}{4}$ yd. of cloth at 12 ct. a yard.
- (b) $6\frac{2}{3}$ acres of land at \$18 an acre.
- (c) $8\frac{5}{8}$ tons of hay at \$12 a ton.

27. Multiply : (a) $8\frac{1}{2} \times 12\frac{1}{2}$.
 (b) $16\frac{1}{2} \times 3\frac{3}{4}$.
 (c) $24\frac{2}{3} \times 20\frac{5}{6}$.

SOLUTION. — $8\frac{1}{2} \times 4\frac{1}{2} = 4$ times 8 + $\frac{1}{2}$ of 8 + 4 times $\frac{1}{2}$ + $\frac{1}{4}$ of $\frac{1}{2}$ or

$$\begin{array}{r} 8\frac{1}{2} \\ \underline{4\frac{1}{2}} \\ 32 \\ \underline{2} \\ 2\frac{1}{2} \\ \underline{36\frac{1}{2}} \end{array}$$

28. Find the cost of :

- (a) $12\frac{1}{2}$ bushels of potatoes at $24\frac{2}{3}$ ct. a bushel.
- (b) $20\frac{2}{3}$ gallons of milk at $12\frac{3}{4}$ ct. per gallon.
- (c) $36\frac{3}{4}$ pounds of nails at $8\frac{1}{2}$ ct. per pound.

DIVISION OF FRACTIONS

Exercise 52

1. At $\frac{1}{2}$ a cent each, how many apples can be bought for 3 ct.? 7 ct.?

2. At $\frac{1}{5}$ of a cent each how many gumdrops can be bought for 4 ct.? 6 ct.?

3. If a pound of butter costs $\frac{1}{4}$ of a dollar, how many pounds can be bought for \$1? \$2? \$2 $\frac{1}{2}$? \$10?

4. If a gallon of milk costs $\frac{1}{10}$ of a dollar, how many gallons can be bought for \$3? \$4? \$4 $\frac{1}{2}$?

5. Divide: (a) 1 by $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$.

(b) 3 by $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{6}$.

(c) 9 by $\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{6}$, and $\frac{1}{7}$.

6. At $\frac{2}{3}$ of a cent each how many pencils can be bought for 6 ct.? 9 ct.? 12 ct.?

SUGGESTION. — 6 is how many thirds? $\frac{1}{3}$ contains $\frac{2}{3}$ how many times?

7. At $\frac{3}{4}$ of a dollar each how many bushels of wheat can be bought for \$9? \$12? \$15? \$18?

8. If a pound of tea costs $\frac{3}{5}$ of a dollar, how many pounds can be bought for \$3? \$7? \$10?

9. Divide: (a) 6 by $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$.

(b) 9 by $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$.

(c) 12 by $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$.

10. Divide:

(a) $\frac{2}{3}$ by $\frac{3}{4}$. (d) $\frac{5}{6}$ by $\frac{2}{3}$. (g) $\frac{7}{10}$ by $\frac{2}{5}$. (j) $\frac{4}{6}$ by $\frac{2}{3}$.

(b) $\frac{3}{4}$ by $\frac{5}{6}$. (e) $\frac{3}{8}$ by $\frac{4}{5}$. (h) $\frac{3}{8}$ by $\frac{3}{4}$. (k) $\frac{5}{12}$ by $\frac{3}{4}$.

(c) $\frac{7}{8}$ by $\frac{3}{4}$. (f) $\frac{5}{9}$ by $\frac{6}{7}$. (i) $\frac{3}{4}$ by $\frac{3}{8}$. (l) $\frac{9}{10}$ by $\frac{3}{8}$.

SUGGESTION. — Make similar fractions. For example, $\frac{2}{3} \div \frac{3}{4}$ is $\frac{8}{9}$ by $\frac{1}{2} = \frac{4}{9}$, Ans.

11. Divide :

(a) $\frac{3}{4}$ by 3.

(d) 8 by $\frac{3}{7}$.

(g) $\frac{7}{10}$ by $\frac{3}{8}$.

(b) $\frac{4}{7}$ by 2.

(e) 7 by $\frac{2}{3}$.

(h) $\frac{9}{12}$ by $\frac{4}{5}$.

(c) $\frac{5}{6}$ by 5.

(f) 9 by $\frac{4}{5}$.

(i) $\frac{15}{16}$ by $\frac{3}{4}$.

12. How often is :

(a) $\frac{3}{4}$ of a gallon contained in 6 gallons ?

(b) $\frac{4}{5}$ of a bushel contained in 12 bushels ?

(c) $\frac{5}{6}$ of a pound contained in 15 pounds ?

(d) $\frac{2}{3}$ of a foot contained in 6 yards ?

13. How many bags of wheat at $\frac{4}{5}$ of a dollar a bag can be bought for $\frac{5}{4}$ of a dollar ?

14. At $\frac{2}{3}$ of a dollar a pair, how many pairs of rubbers can be bought for \$6 ?

15. If Harry saves $\frac{3}{4}$ of a dollar and Tom $\frac{1}{2}$ a dollar a week, how long will both take to save 15 dollars ?

16. (a) Divide $\frac{3}{4}$ by $\frac{2}{5}$. (b) Multiply $\frac{3}{4}$ by $\frac{5}{2}$.

Compare the results of *a* and *b*. Compare questions *a* and *b*. Obtain a simple method of dividing any number by a fraction.

17. Using the rule found, divide :

(a) $\frac{2}{3}$ by 2.

(d) 3 by $\frac{2}{3}$.

(g) $\frac{9}{16}$ by $\frac{3}{4}$, $\frac{2}{3}$, and $\frac{7}{8}$.

(b) $\frac{3}{8}$ by 4.

(e) 5 by $\frac{4}{5}$.

(h) $\frac{3}{4}$ by $\frac{2}{3}$, $\frac{4}{5}$, and $\frac{5}{8}$.

(c) $\frac{9}{10}$ by 5.

(f) 6 by $\frac{5}{6}$.

(i) $\frac{7}{9}$ by $\frac{5}{4}$, $\frac{2}{3}$, and $\frac{3}{8}$.

18. Divide :

(a) $7\frac{1}{2}$ by $\frac{3}{4}$.

(c) $10\frac{5}{6}$ by $\frac{4}{5}$.

(e) $20\frac{1}{2}$ by $\frac{5}{8}$.

(b) $8\frac{2}{3}$ by $\frac{1}{5}$.

(d) $12\frac{2}{3}$ by $\frac{3}{4}$.

(f) $6\frac{1}{8}$ by $\frac{3}{4}$.

SUGGESTION. — $7\frac{1}{2}$ is $\frac{15}{2}$. $\frac{15}{2} \div \frac{3}{4} = \frac{15}{2} \times \frac{4}{3} = 10$, Ans.

Exercise 53 (Review)

1. Reduce to their lowest terms:

$$\frac{39}{91}, \frac{57}{190}, \frac{117}{273}, \frac{69}{230}, \frac{84}{144}, \frac{195}{405}, \frac{735}{630}, \frac{180}{324}, \frac{210}{336}.$$

2. Reduce:

$$(a) \frac{1}{2}, \frac{3}{4}, \frac{5}{6}, \text{ and } \frac{7}{12} \text{ to sixtieths.}$$

$$(b) \frac{3}{7}, \frac{1}{12}, \frac{2}{3}, \text{ and } \frac{5}{6} \text{ to eighty-fourths.}$$

$$(c) \frac{5}{6}, \frac{4}{7}, \frac{4}{5}, \text{ and } \frac{2}{3} \text{ to two hundred and tenths.}$$

3. Reduce to simplest common denominator:

$$(a) \frac{2}{3}, \frac{5}{6}, \text{ and } \frac{3}{4}.$$

$$(b) \frac{8}{9}, \text{ and } \frac{7}{12}$$

$$(c) \frac{1}{3}, \frac{1}{4}, \text{ and } \frac{1}{5}.$$

4. Add:

$$(a) \frac{3}{5} + \frac{5}{6} + \frac{6}{12}.$$

$$(b) \frac{2}{3} + \frac{3}{4} + \frac{5}{8}.$$

$$(c) \frac{2}{5} + \frac{2}{3} + \frac{3}{10}.$$

5. Subtract.

$$(a) \frac{3}{4} \text{ from } \frac{7}{8}.$$

$$(b) \frac{8}{9} \text{ from } 1\frac{1}{12}.$$

$$(c) \frac{4}{9} \text{ from } \frac{5}{8}.$$

6. Find the value of:

$$(a) \frac{5}{6} \text{ of } \frac{2}{7}.$$

$$(b) \frac{5}{8} \text{ of } \frac{4}{9}.$$

$$(c) \frac{7}{5} \text{ of } \frac{5}{7}.$$

7. Find the simplest value of:

$$(a) \frac{75 \times 63 \times 27}{100 \times 48 \times 72}.$$

$$(b) \frac{42 \times 57 \times 26}{21 \times 91 \times 19}.$$

$$(c) \frac{32 \times 38 \times 39 \times 45}{80 \times 95 \times 91 \times 60}.$$

8. Multiply:

(a)

$\frac{1}{2} \times \frac{2}{3}.$

$\frac{2}{7} \times \frac{3}{4}.$

$\frac{8}{9} \times \frac{5}{6}.$

(b)

$4\frac{2}{3} \times 9.$

$8\frac{3}{4} \times 12.$

$20\frac{5}{8} \times 18.$

(c)

$8\frac{2}{3} \text{ by } 9\frac{1}{4}.$

$9\frac{3}{4} \text{ by } 12\frac{2}{3}.$

$15\frac{1}{2} \text{ by } 10\frac{3}{5}.$

9. Divide:

(a) $\frac{1\frac{2}{5}}{\frac{1}{6}}$ by 6.

(b) $\frac{6}{8}$ by 3.

(c) $\frac{9}{10}$ by 4.

(d) 12 by $\frac{3}{4}$.

(e) 15 by $\frac{2}{3}$.

(f) 10 by $\frac{1}{2}$.

(g) $\frac{5}{8}$ by $\frac{1}{3}$.

(h) $\frac{1}{4}$ by $\frac{5}{6}$.

(i) $\frac{4}{9}$ by $\frac{5}{2}$.

10. Harry received the following sums at different times: \$8 $\frac{2}{5}$, \$5 $\frac{3}{4}$, \$6 $\frac{7}{10}$, and \$2 $\frac{1}{2}$. How much did he receive all together?

11. A tailor cut from a web of cloth containing 40 yd. the following lengths: 3 $\frac{1}{2}$ yd., 2 $\frac{1}{3}$ yd., 6 $\frac{1}{4}$ yd., and 5 $\frac{3}{8}$ yd. How many yards were left?

12. A gentleman gave 3 tons of coal to be divided equally among a number of poor families, giving each $\frac{3}{8}$ of a ton. Find how many families shared the gentleman's charity.

13. If $\frac{7}{8}$ of a ton of hay costs \$8.40, find the cost of 36 $\frac{5}{8}$ tons of hay.

DECIMAL FRACTIONS

Exercise 54

1. (a) Read as dollars and cents: \$12.34, \$23.45, \$34.56, and \$.89.

(b) What is the purpose of the mark (.)? It is called the *decimal point*.

(c) What part of a dollar does the first figure to the right of the decimal point represent?

(d) What part of a dollar does the second figure to the right of the decimal point represent?

(e) What part of a dollar do both figures to the right of the decimal point represent?

(f) What part of a dollar will the third figure to the right of the decimal point in \$93.789 represent? What will the three figures after the decimal point in this amount represent?

2. Read the following sums as parts of a dollar: \$.76, \$.89, \$.46, \$.70, \$.80, \$.07, and \$.09.

3. Read as hundreds, tens, and units the following: 111, 222, 333, 444, 555, 666, 777, and 888.

4. The tens' place in each of the numbers in question 3 is how many times the units' place? The hundreds' place is how many times the tens' place? How many times the units' place?

5. The tens' place in each of the numbers in question 3 is what part of the hundreds' place? The units' place is what part of the tens' place? What part of the hundreds' place?

6. If what you found in questions 4 and 5 is still true, what meaning must you give to the following, the figure to the left of the decimal point always representing the units' place:

111.1, 222.2, 333.3, 444.4, 555.5, 666.6, and 777.7?

7. The figure to the left of the decimal point in each of the numbers given in question 6 is how many times the value of the figure to the right of the decimal point? The figure to the right of the decimal point is what part of the value of the figure to the left of the decimal point?

8. Read the following:

7.8, 19.3, 464.7, 2000.9, 7248.5, 66847.2.

9. If the meaning found true in questions 5 and 6 still holds, what will the figures two places to the right of the decimal point represent in: 111.11, 222.22, 333.33, 444.44, 555.55, 666.66, and 777.77?

10. These are all what part of the value of the figure to their left? What part of the value of the units' figure?

11. Read the following numbers, giving each figure its value: 725.63, 897.59, 400.60, 568.07, 936.94.

12. Show that .72 is seventy-two hundredths, .95 is ninety-five hundredths, and .48 is forty-eight hundredths.

13. Read the following as hundredths:

.46, .38, .93, .72, 58, .89, .67, and .33.

14. 111.111, 222.222, 333.333, 777.777.

(a) Read the third figure to the right of the decimal point in each of the above numbers.

(b) Read each number, giving the place value of its figures.

(c) Read each number, giving the decimal part in thousandths.

15. Read as thousandths:

.428, .756, .937, .420, .500, and .606.

16. Read the following numbers:

(a) .3, .37, .375, .043, .006, and .107.

(b) 4.3 tons, 7.35 tons, and 8.648 tons.

(c) 5.2 days, 9.36 days, and 23.465 days.

17. Write in figures:

(a) Seventy-three and eight tenths; four thousandths; nine hundred and six and fifty-six hundredths; four hundred and two thousandths.

(b) Seven tenths; eighty-nine hundredths; sixteen thousandths.

18. Write as decimal fractions:

$$\frac{7}{10}, \frac{18}{100}, \frac{827}{1000}.$$

19. Write as vulgar (common) fractions: .6, .25, and .750.

20. Read the following:

(a) .7, .70, .700. (b) .9, .90, .900. (c) .6, .60, .600.

How do the numbers in *a* compare in value? How do those in *b*? How those in *c*?

21. Read and compare the following:

(a) 7, 07, 007. (b) 9, 09, 009. (c) 8, 08, 008.

22. Make a statement as to the effect upon the value of a decimal of placing zeros to the right of *characteristic* figures. (1, 2, 3, 4, 5, 6, 7, 8, and 9 are called characteristic figures because each represents something. Zero represents what?)

Make also a statement as to the effect of placing zeros to the left of a whole number.

Study the plan of the following. Notice that the last figure gives the name to the number, thus reading: eight thousand four hundred and twenty-seven *and* nine hundred and thirty-six *thousandths*.

23.

Thousands	Hundreds	Tens	units	decimal	tenths	hundredths	thousandths
8	4	2	7	.	9	3	6

24. Write in words the following:

4.7	19.24	212.04	423.156	1248.5
15.6	36.25	216.10	243.056	3267.78
234.87	140.32	318.97	728.007	9286.903

25. Write in figures:

Eight tenths, seventy-five hundredths, fifty-six thousandths. Nine tenths, seven hundredths, eight thousandths. Seven and five tenths, two and thirteen hundredths, two hundred and four thousandths. Nineteen tenths, twenty-four hundred and sixty-eight hundredths, and forty-two hundred and sixty-seven thousandths. Three hundred, and forty-two thousandths; three hundred and forty-two thousandths.

ADDITION OF DECIMALS**Exercise 55**

1. Write as decimals: 71 tenths, 56 tenths, 16 tenths, 24 tenths, 29 tenths. 746 hundredths, 800 hundredths, 7268 thousandths, and 40002 thousandths.

2. Arrange for addition the following:

(a) 726, 897, 248, 369, and 792.

(b) \$39.75, \$46.28, \$72.30, and \$169.25.

(c) 2 yd. 1 ft. 5 in., 7 yd. 2 ft. 3 in., and 5 yd. 2 ft. 10 in.

(d) 3 gal. 2 qt. 1 pt., 7 gal. 3 qt. 2 pt., and 4 gal. 3 qt. 1 pt.

3. Arrange for purposes of addition:

(a) $72.48 + 96.56 + 24.03 + 99.5 + 86.23 + 46.58$.

(b) $216.5 + 428.6 + 325.29 + 425.54 + 625.423 + 88.006$.

(c) 27 tenths + 83 hundredths + 46 tenths + 756 hundredths + 824 thousandths + 7246 thousandths.

4. Add:

46.7	93.72	93.64	99.87	38.463	1.320
38.49	48.09	46.05	68.76	72.594	3.068
72.03	76.5	73.37	57.65	83.621	7.8
<u>46.48</u>	<u>93.72</u>	<u>66.44</u>	<u>46.54</u>	<u>75.006</u>	<u>9.76</u>

5. Add:

(a) $6.6 + 77.77 + 555.444 + 72.348 + 96.9 + 1.2 + 5.401 + .004.$

(b) $14.43 + 17.8 + 96.009 + 125.321 + 648.72 + 900.009 + 1.001.$

(c) $73.437 + 7.201 + 98.007 + 15.401 + 384.7 + 3.05 + 11.3 + 14.281.$

(d) $361.126 + 8.351 + 10.004 + 136.28 + 8.37 + 14.03 + 136.489.$

(e) $17.01 + 8.005 + 6.241 + 48.351 + 17.085 + 16 + 65.413 + .02.$

(f) $10.164 + .234 + .46 + .9 + 8.42 + 90.09 + 16.132 + .001.$

(g) $18.35 \text{ yd.} + 24.28 \text{ yd.} + 16.05 \text{ yd.} + 72.37 \text{ yd.} + 19.91 \text{ yd.} + 18.63 \text{ yd.}$

(h) $72.6 \text{ lb.} + .02 \text{ lb.} + 24.232 \text{ lb.} + 46.321 \text{ lb.} + 90.386 \text{ lb.} + 2.307 \text{ lb.}$

6. Add:

(a) Seventy-two hundredths, two hundred and six and six tenths, eight hundred and twenty-seven and fifty-three thousandths.

(b) Six thousandths, twenty-three and twenty-three hundredths, seven and seven tenths, eighty-six and one hundred and five thousandths.

(c) Forty-two and three hundred and one thousandths, seventy-seven and fifteen hundredths, ninety-six and five thousandths.

7. Six bags of wheat contain the following weights: 89.3 lb., 72.63 lb., 73.45 lb., 92.7 lb., 90.01 lb., and 88.08 lb. Find the total weight of wheat in the whole.

8. A train travelled 36.5 miles the first hour, 38.72 miles the second hour, and 47.34 miles the third hour. Find how far the train went in the three hours.

9. I invested .2 of my money in cattle, .3 of my money in horses, and .47 of my money in land. What part of my money have I invested?

SUBTRACTION OF DECIMALS

Exercise 56

1. Find the difference between: \$72.16 and \$48.79, \$60.00 and \$43.75, \$8 and \$.90.

2. Subtract:

89.72	42.3	26.84	48.30	47.607	72.163
<u>76.98</u>	<u>14.7</u>	<u>13.95</u>	<u>23.65</u>	<u>25.698</u>	<u>16.935</u>

3. Find the difference between:

(a) 6.825 and 4.75, 61.002 and 1.931, 19.05 and 5.89.

(b) 73.075 and 32.176, 84.34 and 76.8, 90.091 and 72.38.

(c) 20.468 and 15.579, 56 and .9, 7 and .435.

4. Simplify:

(a) $84.26 + 93.75 - 48.321$.

(b) $70.09 - 15.387 + 63.342$.

(c) $72.45 + 83.96 - 12.621 - 13.123$.

5. From a lot containing 40 acres 23.469 acres are sold. How large is the remaining part?

6. A family used 6.725 tons of coal out of a bin containing 10.32 tons. How much coal remained?

7. Mr. Brown's property amounted to \$6848.75 when he died. Accounts to the amount of \$2346.89 were paid out of this. How much was left to the heirs?

8. The area of a garden is 428.375 sq. ft. If 100.46 sq. ft. is set apart for cabbage plants, 143.386 sq. ft. for potatoes, and the remainder for onions, find how many square feet are in the bed of onions.

9. A, B, C, D, and E are five cities situated along the same railroad. The distance from A to B is 17.23 miles, from B to C 25.637 miles, from C to D 87.125 miles, and from D to E 20.06 miles. Find the distance from A to E, from B to D, and from D to A.

10. What is the difference between a thousand miles and three hundred and fifty-six thousandths miles? Seventy two hundred lb. and 72 hundredths lb.?

11. Write in words 300.056, and in figures three hundred and fifty-six thousandths.

NOTE. — The punctuation makes the difference clear; see that it is understood.

12. To how many pounds of rice must 72.087 lb. of rice be added to make a total of 100 lb.?

13. A man travelled westwards 72.48 miles, then eastwards 56.527 miles, and back westwards 100.624 miles. How far is he from his starting-point?

MULTIPLICATION OF DECIMALS

Exercise 57

1. Read the following numbers, giving each figure its place value: 42.87, 73.63, 96.9, 42.5, 72.321, and 65.007.

2. Compare the numbers 624, 62.4, 6.24, and .624.

(a) The third number is what part of the second? What part of the fourth?

(b) The second number is what part of the first? What part of the third?

(c) The fourth number is what part of the third?

(d) The first number is how many times the second? How many times the third? How many times the fourth?

3. Multiply:

624×3 ; 62.4×3 ; 6.24×3 , and $.624$ by 3. (Observe what you said in question 2 regarding these numbers.)

4. In each of the questions under question 3 compare the multiplicand and the product. How will this help you to place the decimal point in the product?

5. If each of the numbers 436.9, 72.93, and 61.037 be multiplied by 2, 3, 4, 5, 6, 7, 8, or 9, how many places will be after the decimal point in each product?

6. To multiply 84.22 by 9 we may proceed as we would in ordinary multiplication, and say:

(a) 7 times 2 hundredths are 18 hundredths, or 1 tenth and 8 hundredths. Set down the 8 hundredths in the hundredths' place and carry the one tenth to the next place.

(b) 9 times 2 tenths are 18 tenths and 1 tenth are 19 tenths or 1 unit and 9 tenths. Set down the 9 tenths in the tenths' place, place the decimal point to its left, carry the units to the next place and so on.

7. Find the following products:

(a) 4.7×5	5.6×7	2.34×2	4.213×3
(b) 3.8×6	8.3×5	3.41×3	5.314×4
(c) 9.6×7	9.4×8	7.62×4	6.415×5
(d) 12.4×8	14.5×9	5.48×7	7.516×6

8. Find the cost of:

- (a) 7 yards of ribbon at 8.57 ct. per yard.
- (b) 6 gallons of milk at 32.4 ct. per gallon.
- (c) 9 pounds of tea at 45.72 ct. per pound.
- (d) 8 acres of land at \$43.85 per acre.

9. Multiply 486.7, 724.63, and 821.156 each by 10.

State how multiplying a decimal by 10 affects the place of the decimal point of the multiplicand.

10. Find the following products:

846.3×10 ; 728.93×10 ; 426.246×10 ; $.7 \times 10$; $.76 \times 10$,
and $.476 \times 10$.

11. Multiply each of the following numbers by 100:

3.278, 463.97, and 72.8.

Make a statement as to how a decimal quantity may be
most readily multiplied by 100; by 1000.

12. Multiply:

(a) 428.639 by 100

(b) 726.439 by 1000

42.86 by 100

62.73 by 1000

4.8 by 100

8.9 by 1000

13. Find as in question 6 the following products:

(a) $.5 \times 12$, $.8 \times 20$, 1.7×24 , and 4.9×30 .

(b) $.86 \times 15$, $.74 \times 22$, 6.34×26 , and 9.38×40 .

(c) $.328 \times 9$, $.456 \times 12$, $.321 \times 24$, and $.006 \times 18$.

(d) 4.021×9 , 5.123×13 , 7.298×18 , and 9.005×24 .

14. Find the cost of:

(a) 72 bags of flour at \$3.75 a bag.

(b) 48 bushels of potatoes at \$.85 each.

(c) 64 acres of land at \$17.23 an acre.

Exercise 58

1. Compare the numbers in each of the following pairs
of numbers:

(a) 6 and .6.

(b) 4 and .4.

(c) 8 and .8.

2. Compare the products obtained in the following sets:

(a) 18×6 and $18 \times .6$; 21×6 and $21 \times .6$; 37×6 and
 $37 \times .6$.

(b) 18×4 and $18 \times .4$; 21×4 and $21 \times .4$; 37×4 and
 $37 \times .4$.

State what you have found as the result of the foregoing
comparison.

3. Multiply:

(a) 849 by 7 and 849 by .7.

(b) 748 by 18 and 748 by 1.8.

4. Compare the numbers in each of the following groups:

(a) 3, .3, and .03.

(b) 4, .4, and .04.

5. Compare the products obtained in the following groups:

(a) 17×3 , $17 \times .3$, $17 \times .03$.(b) 24×4 , $24 \times .4$, $24 \times .04$.

6. Multiply:

(a) 48 by each of the following multipliers, 6, .6, .06, and 6.66. Compare.

(b) 73 by each of the following multipliers, 8, .8, .08, and 8.88. Compare.

7. When 4286 is multiplied by 8, the product is 34,288. What would the product be if the multiplier were .8? What would it be if the multiplier were .08?

8. Find and retain the following products:

(a) $83 \times .9$, $83 \times .93$, $83 \times .934$.(b) $79 \times .8$, $79 \times .84$, $79 \times .845$.(c) $96 \times .7$, $96 \times .76$, $96 \times .763$.

9. (a) How many decimal places were found in each of the foregoing products?

(b) Compare the number of decimal places in each product with the number of decimal places in the corresponding multiplier.

(c) Make a statement as to what you have discovered.

10. Find the following products:

(a) 72×8 , 86×13 , 64×37 , 83×42 ?(b) 63×9 , 72×14 , 47×45 , 93×324 .(c) 77×7 , 99×15 , 56×63 , 103×125 .

11. Find, without multiplying, the products of :

(a) $72 \times .8$, 86×1.3 , $64 \times .37$, 83×4.23 .

(b) $63 \times .9$, 72×1.4 , $47 \times .45$, 93×3.24 .

(c) $77 \times .7$, 99×1.5 , $56 \times .63$, 103×1.25 .

SUGGESTION. — Compare the parts of questions 11 and 10. Use what you found in question 9 (c).

12. Multiply :

(a) $86 \times .4$, $93 \times .23$, and 76 by 3.4.

(b) $94 \times .6$, $72 \times .63$, and 49 by 7.23.

(c) $321 \times .8$, $423 \times .72$, and 867 by 9.43.

(d) 423×1.3 , 161×2.31 , and 1246 by 3.23.

13. Compare the following multiplicands: 9, .9, and .09. How are these related? Compare also the following multipliers 8, .8, and .08. How are these multipliers related?

14. Multiply and retain the products of :

(a)	(b)	(c)
9×8 ,	$9 \times .8$,	$.9 \times .8$,
$.9 \times 8$,	$9 \times .08$,	$.09 \times .08$,
$.09 \times 8$,	$9 \times .008$,	$.009 \times .008$,
1.9×8 .	1.9×1.8 .	1.09×1.08 .

Make a statement as to the number of decimal places in each of the foregoing products and compare this number with the sum of the decimal places in the multiplier and multiplicand.

15. Find the following products :

(a) 746×8 , 74×83 , 432×314 .

(b) 832×9 , 96×72 , 536×618 .

(c) 725×7 , 28×37 , 725×817 .

(d) 626×6 , 93×39 , 936×213 .

16. Find without multiplying the following products:

(a) $74.6 \times .8$, $7.4 \times .83$, 4.32×31.4 .

(b) $83.2 \times .9$, $9.6 \times .72$, 53.6×61.8 .

(c) $72.5 \times .7$, $.28 \times 3.7$, 72.5×8.17 .

(d) $62.9 \times .6$, $.93 \times 3.9$, $936 \times .213$.

SUGGESTION. — Compare questions 15 and 16, and use what you found in question 14.

17. Find the following products:

(a) 937×1.8 , 62.3×4.9 , $72.4 \times .49$, $12.9 \times .31$.

(b) 46.3×1.9 , 73.8×5.8 , 83.6×2.38 , 1.29×3.1 .

(c) $7.24 \times .3$, 66.9×6.7 , 9.24×3.7 , $.129 \times 31$.

18. Find the cost of:

(a) 74.6 acres of land at \$24.35 per acre.

(b) 63.57 bushels of oats at 25.6 ct. per bushel.

(c) 87.42 cords of wood at \$8.75 per cord.

19. Find the product of:

(a) 436.5×13 , 788.6×24 , 32.9×30 .

(b) 43.65×13 , 75.86×24 , 3.29×30 .

(c) $4.365 \times .13$, 7.586×24 , $.329 \times 30$.

(d) $24 \times .3$, $27 \times .8$, $36 \times .9$.

(e) $24 \times .34$, $27 \times .85$, $37 \times .89$.

(f) $24 \times .347$, $27 \times .856$, $48 \times .893$.

(g) $2.4 \times .3$, $7.23 \times .4$, $8.345 \times .5$.

(h) $3.24 \times .4$, $7.23 \times .34$, $8.345 \times .56$.

(i) 7.412×1.4 , 7.834×2.76 , 7.345×4.321 .

DIVISION OF DECIMALS

Exercise 59

1. Read, as decimals, \$89.76, \$43.20, \$97.05, and \$1248.64.

2. Divide \$84.48 by 4, \$72.27 by 3, \$94.65 by 5. How did you get the decimal point in each of these questions?
3. Divide 48.72 by 3, 75.85 by 5, and 864.96 by 6.
4. Divide:
- (a) 60.99, 86.64, 139.46, and 255.55 each by 19.
 - (b) 17.52, 20.16, 29.04, 109.44, and 1037.04 each by 24.
 - (c) 47.25, 90.30, 485.10, 466.20, and 345.45 each by 105.
5. Compare the following:
- (a) 72 and 7.2, 84 and 8.4, 96 and 9.6, 105 and 10.5.
 - (b) 348 and 3.48, 695 and 6.95, 752 and 7.52, 8 and .08.
6. Compare the quotients when:
- (a) 72 and 7.2 are each divided by 8; 84 and 8.4 each divided by 6; 105 and 10.5 each divided by 5.
 - (b) 348 and 3.48 are each divided by 3; 695 and 6.95 each divided by 5; 752 and 7.52 each divided by 8.
7. Divide 27,648 by 8, 66,141 by 9, and 53,466 by 7.
8. Write the quotients of the following without actually dividing: 27.648 by 8, 6614.1 by 9, and 534.66 by 7.
- (Notice the resemblance of questions 7 and 8.)
9. Divide 46.345 by 5, 195.729 by 9, and 860.848 by 8.
10. Find the cost of a single article if:
- (a) 8 articles cost \$720.64.
 - (b) 9 articles cost \$84.519.
11. A floor is 15.8 ft. long and 12.6 ft. wide. How many square yards of surface are there?
12. Divide:
- | | | | |
|------------|-------------|-------------|--------------|
| 3.172 by 2 | 432.65 by 5 | 4.23 by 3 | 927.729 by 9 |
| 317 by 2 | 234 by 5 | 40.122 by 3 | 83.862 by 9 |
| 360.6 by 4 | 41.328 by 8 | 5.94 by 6 | .819 by 9 |
| 31 by 4 | 24 by 8 | 7.147 by 7 | .009 by 9 |

13. Multiply:

- | | | |
|-----------------|-----------------|------------------|
| (a) 46.3 by 10. | (c) 9.75 by 10. | (e) 8.435 by 10. |
| (b) 72.6 by 10. | (d) 8.64 by 10. | (f) 7.618 by 10. |

14. Divide:

- | | | |
|----------------|-----------------|------------------|
| (a) 463 by 10. | (c) 97.5 by 10. | (e) 84.35 by 10. |
| (b) 726 by 10. | (d) 86.4 by 10. | (f) 76.18 by 10. |

Give a rule for dividing a decimal number by 10.

15. Divide the following by 10:

8.64 73.89 21.694 327.218 9160.098

16. Multiply:

- | | | |
|------------------|-------------------|-----------------|
| (a) 7.26 by 100. | (c) 3.416 by 100. | (e) .8 by 100. |
| (b) 8.32 by 100. | (d) 7.218 by 100. | (f) 7.8 by 100. |

17. Divide:

- | | | |
|-----------------|-------------------|-----------------|
| (a) 726 by 100. | (c) 341.6 by 100. | (e) 80 by 100. |
| (b) 832 by 100. | (d) 721.8 by 100. | (f) 780 by 100. |

Give a rule for dividing decimals by 100.

18. Divide the following numbers by 100:

9.364 721.63 84.3 .87 9 and .9

Exercise 60

1. What would you do were you asked to divide the following:

- (a) 15 yards 2 feet by 6 feet?
- (b) 16 pounds 12 ounces by 8 ounces?

2. What would you do were you asked to divide:

- (a) 18 by 3 tenths?
- (b) 15 by 3 hundredths?

3. Write the following so that the dividend and the divisor shall have the same name:

(a) $12 \div .4$, $36 \div 1.8$, $70 \div .5$, $75 \div 1.5$, and $8.5 \div 17$.

(b) $8 \div .24$, $72 \div .04$, $96 \div 8.4$, $720 \div .36$, and $9.6 \div .24$.

4. Divide:

84 by 8

256 by 16

625 by 25

8.4 by 8

25.6 by 1.6

625 by 2.5

.84 by 8

2.56 by .16

625 by .25

84 by .8

25.6 by .16

62.5 by .25

84 by .08

256 by .16

6.25 by .25

8.4 by .8

18 by 4

6.25 by 2.5

.84 by .8

18 by .4

6.25 by 25

5. Compare the following quotients:

(a)

(b)

(c)

(d)

$15 \div 3$

$18 \div 6$

$24 \div 12$

$42 \div 7$

$30 \div 6$

$36 \div 12$

$48 \div 24$

$84 \div 14$

$45 \div 9$

$54 \div 18$

$72 \div 36$

$126 \div 21$

$60 \div 12$

$72 \div 24$

$96 \div 48$

$168 \div 28$

$75 \div 15$

$90 \div 30$

$120 \div 60$

$210 \div 35$

Make a statement as to what you have found in the foregoing.

6. Compare the following quotients:

(a)

(b)

(c)

(d)

$7.5 \div 1.5$

$8.5 \div 1.9$

$57 \div 1.9$

$84 \div .42$

$75 \div 15$

$85 \div 19$

$570 \div 19$

$8400 \div 42$

Why are the quotients in the foregoing the same?

Which is the easier division to make?

Give a rule by which any division of decimals may be most simply done.

7. Multiply each of the following decimals by such a number as will give whole numbers for products:

7.8, 8.26, 9.334, .4, .04, and .004.

8. By what number must you multiply the divisor and the dividend in each of the following that both may be changed to whole numbers?

$7.8 \div 1.7$	96.5 by 5	72 by .72
$7.8 \div .17$	9.65 by .5	72 by 7.2
$.78 \div .17$.965 by .05	7.2 by .72
$.78 \div 1.7$	965 by .05	.72 by 7.2

9. Divide, by first removing the decimals (that is, get corresponding divisions in whole numbers), the following:

647.425 by 8.93	3696 by 5.5
688.018 by 7.43	267.88 by .37
1551.54 by 32.6	408.24 by 3.24
1108.8 by 4.8	3876.999 by 5.23

10. How many pounds of tea at 45.8 cents per pound can be bought for \$14.9766?

11. If 4.5 yards of ribbon cost 56.7 cents, find the cost of 18.9 yards.

12. If 7.25 bushels of wheat will fill a bin, how many bins of the same size will hold 725 bushels?

13. Hay is worth .75 cents per pound. How many pounds can be purchased for \$13.98?

REVIEW

Exercise 61

1. Find the cost of:

- (a) 14 yards 2 feet 6 inches of rope at 6 cents a foot.
- (b) 8 yards 1 foot 6 inches of cloth at 12 cents a yard.
- (c) 2 feet 3 inches of ribbon at 36 cents a yard.

3. Find the cost of:

- (a) 8 rods 3 yards of piping at 18 cents a foot.
- (b) 20 rods 5 yards 1 foot 6 inches of wall at \$6 a rod.
- (c) 1 mile 60 rods of fencing at \$2.20 a rod.

3. Find the cost of painting:

- (a) A floor 62 feet by 54 feet at 20 cents per square yard.
- (b) A fence 6 feet high (tight) around a lot 60 feet long and 36 feet wide at 12 cents per square yard.
- (c) The gable of a barn 20 feet from base to apex and 72 feet wide at 30 cents per square yard.

4. How many acres in:

- (a) A piece of land 96 rods long and 16 rods wide?
- (b) A lane 2 miles long and 2 chains wide?
- (c) A roadway $2\frac{1}{2}$ miles long and $\frac{1}{4}$ mile wide?

5. How many cubic feet of earth must be thrown out in order to dig:

- (a) A cellar 40 feet long, 36 feet wide, and 6 feet deep?
- (b) A ditch 6 feet wide at the top, 2 feet wide at the bottom, 3 feet deep, and 10 rods long?
- (c) A well 20 feet deep and 6 feet square?

6. How many cords of wood in:

- (a) A pile 900 feet long, 16 feet wide, and 12 feet high?
- (b) 240 loads each 12 feet long, 4 feet wide, and 4 feet high?
- (c) 256 pieces of squared timber each 12 feet long and a foot square?

7. How many cubic yards in:

- (a) A room 24 ft. long, 18 ft. wide, and 12 ft. high?
- (b) A box 72 inches long, 60 inches wide, and 27 inches deep?
- (c) A pile of sand 36 ft. long, 27 ft. wide, and 20 ft. deep?

8. Find the cost of:

- (a) 7500 lb. of coal at \$9 per ton.
- (b) 5375 lb. of hay at 72 ct. per hundredweight.
- (c) 7500 lb. of wheat at 81 ct. per bushel of 60 lb

9. How many widths of carpet will be required to carpet a room:

- (a) 27 ft. long, 13 ft. wide, carpet 27 in. wide?
- (b) 40 ft. long, 36 ft. wide, carpet 24 in. wide?

10. How many yards of carpet will it take to carpet the following rooms if the widths of carpet run from end to end of the room:

- (a) A room 81 ft. long, 60 ft. wide, carpet 30 in. wide?
- (b) A room 120 ft. long, 72 ft. wide, carpet 36 in. wide?

11. Add both vertically and horizontally the following:

	A	B	C	D	E	F	TOTALS
1	\$42.63	\$18.23	\$99.77	\$99.76	\$67.89	\$14.31	\$
2	84.96	71.17	22.44	27.43	78.90	19.26	
3	72.19	66.64	45.61	77.45	78.76	13.72	
4	14.63	46.77	14.56	83.39	87.65	24.33	
5	19.20	15.09	65.47	66.44	76.54	27.66	
6	91.36	86.71	56.74	12.34	65.43	38.97	
7	21.70	43.80	83.97	34.56	54.32	21.42	
8	46.54	77.66	21.54	45.67	43.21	36.59	
Footings	\$	\$	\$	\$	\$	\$	\$

Sum the *footings* and *totals*.

Exercise 62

1. A stationer bought 8 reams of paper at \$2.75 a ream and sold half of it at 25 ct. a quire and the remainder at the rate of 4 sheets for 6 ct. How much was the gain?

2. A boy bought 3 gross of penholders at 90 ct. a gross and sold them at 3 ct. each. How much did he make?
3. A man bought three farms of 240 acres each, at \$7.25 an acre. He built three barns, one on each farm, at a cost of \$821 a barn; and built all together on the farms 1840 rd. of fencing at \$3.20 a rod. He sold the farms at \$17 an acre. Did he gain or lose, and how much?
4. I bought a house and lot for \$5420. After spending \$356 in repairs to the house, I sold it for \$2120 cash and a farm valued at \$5785. How much did I make?
5. Four cheeses weighing respectively $35\frac{1}{2}$ lb., $42\frac{1}{4}$ lb., $37\frac{3}{8}$ lb., and 56.5 lb. were bought at 12 ct. a pound, and sold at once at 15 ct. a pound. How much was made?
6. If 18 lb. of sugar costs as much as 24 lb. of rice, how many pounds of rice are worth 54 lb. of sugar? how many pounds of sugar are worth 54 lb. of rice?
7. If 12 men can do a piece of work in 42 days, find how long 28 men would take to do the same work.
8. Find the cost of:
 - (a) $18\frac{1}{5}$ tons of coal at \$10 a ton.
 - (b) 4250 lb. of coal at \$8 a ton.
 - (c) 7200 feet of lumber at \$20 per thousand.
 - (d) 945 lb. of pork at \$9.32 per hundredweight.
 - (e) 432 lb. of bran at 75 ct. per hundred.
9. A grocer mixes 30 lb. of coffee worth 27 ct. a pound, 6 lb. of coffee worth 35 ct. a pound, and 6 lb. of coffee worth 40 ct. a pound. What is the cost of 6 lb. of the mixture?
10. The aggregate attendance at a public school during 157 days was 31,557. Find the average attendance per day.
11. Find the difference in value between 1240 cords of wood at \$5.65 per cord and 1040 tons of coal at \$11 per ton.

12. A horse and buggy costs \$360. The horse cost five times as much as the buggy. Find the cost of each.

13. A workman received \$25 a month and his board for $\frac{2}{3}$ of the year. The remainder of the time he is idle and pays \$17 a month for board. Allowing him \$37 a year for expenses, how much should he be able to save in 4 years?

14. A steamboat can run 12 miles an hour in still water. If such a boat were placed on a river where the current is 3 miles an hour, how far down stream could it run in 18 hours? How long would it take to make the return journey?

15. A farmer bought a wheat field 64 rods long and 40 rods wide for \$240. He paid \$1.80 an acre for cutting and stacking the wheat, 4 ct. a bushel for threshing, and \$3 a load (36 bushels) for teaming to the elevator. The wheat yielded 18 bushels per acre, and was sold at \$1.01 per bushel. How much did the farmer gain or lose?

Exercise 63

1. If $\frac{3}{4}$ of a bushel of wheat be worth 72 ct., what would $\frac{5}{6}$ of a bushel be worth? what would a bushel be worth? what would $\frac{1}{2}$ of a bushel be worth?

2. Reduce the following to their lowest terms:

$$\frac{72}{90}, \frac{45}{63}, \frac{26}{32}, \frac{80}{120}, \text{ and } \frac{32}{108}.$$

3. Add:

$$\frac{1}{2} \text{ and } \frac{2}{3}; \frac{5}{6} \text{ and } \frac{7}{12}; \frac{5}{6} \text{ and } \frac{5}{8}; \frac{1}{4} \text{ and } \frac{3}{8}; \frac{4}{9} \text{ and } \frac{2}{3}.$$

4. Subtract:

$$\frac{2}{3} \text{ and } \frac{1}{2}; \frac{5}{6} \text{ and } \frac{7}{12}; \frac{5}{6} \text{ and } \frac{5}{8}; \frac{4}{9} \text{ and } \frac{1}{3}.$$

5. Multiply:

$$\frac{1}{2} \times \frac{2}{3}; \frac{2}{3} \times \frac{4}{9}; \frac{1}{12} \times \frac{5}{6}; \frac{2}{3} \times 9; 9 \times \frac{2}{3}.$$

6. A merchant had a piece of calico containing 60 yd. He sold $21\frac{3}{5}$ yd.; how much was left?

7. A grocer bought 3 tubs of butter containing $21\frac{3}{4}$ lb..

$24\frac{1}{2}$ lb., and $32\frac{1}{2}$ lb., at 24 ct. a pound, and sold it at 32 ct. a pound. How much did he make?

8. A man set out on a journey of $54\frac{2}{3}$ mi. and travelled $48\frac{2}{9}$ mi. How many miles has he still to go?

9. A lady having \$120 paid \$10 $\frac{1}{4}$ for a hat, \$20 $\frac{1}{2}$ for a dress, and \$56 $\frac{5}{8}$ for a cloak. How much money had she remaining?

10. Find the cost of:

(a) $20\frac{1}{2}$ lb. of steak at $12\frac{1}{2}$ ct. a pound.

(b) $33\frac{1}{3}$ lb. of tea at $45\frac{1}{4}$ ct. a pound.

11. Find the amount of the following account:

$7\frac{1}{2}$ lb. of tea at 8 ct. a pound.

$9\frac{3}{4}$ lb. of beans at 12 ct. a pound.

14 pk. of potatoes at 80 ct. a bushel.

12. Divide: $\frac{3}{4}$ by $\frac{1}{2}$; $\frac{7}{8}$ by $\frac{2}{3}$, and $\frac{1}{6}$ by $\frac{5}{8}$.

13. A man earns \$ $\frac{3}{4}$ a day. In how many days will he earn \$9? \$12? \$15?

14. If I can walk at the rate of $3\frac{2}{3}$ mi. an hour, how long shall I take to walk 11 mi.? 22 mi.?

15. What part of $\frac{3}{4}$ of a peck is $\frac{1}{2}$ a peck?

16. I bought a farm for \$4381.65, a house for \$2472.92, horses for \$728.30, cows for \$346.59, sheep for \$89.75, hogs for \$49.35, and furniture and machinery for \$2000.68. Find the total amount spent.

17. Thomas Whyte sold 57 bags of flour at \$1.85 a bag. His neighbor sold 12 bags less, but received 18 ct. a bag more. How much more did one get than the other?

18. A man sold his house and lot for \$3134.60, and his farm for \$6242.60, and bought city lots at \$47.60 each. How many city lots could he buy?

19. A man has in cash, £100 3s. 6d.; in land, £240 12s.

8*d.*; in farm stock, £125 19*s.* 4*d.*. Find how much he is worth.

20. What is one fourth part of £369 18*s.* and 8*d.*?

21. A dealer sold to one customer 3 T. 5 cwt. 17 lb. bluestone; to another, 4 T. 7 cwt. 35 lb. 12 oz.; and to a third, 3 T. 17 cwt. 80 lb. 6 oz. How much bluestone did he sell all together?

22. If 31 cwt. 18 lb. of rice be put up in boxes of 3 lb. 8 oz., how many boxes will be required? How many ounces of rice will be left?

23. How long would it take a man to complete a journey of 20 mi. at the rate of 3.5 mi. an hour? If he set out at 10 A.M., at what time would he finish it?

24. How many:

(a) pints of milk in 16 gal. 3 qt. 1 pt. of milk?

(b) bushels in 2774 qt.?

(c) gallons in 6324 gi.?

25. A man bought 14 bags of beans, each holding 3 bu. 3 pk. for \$21, and sold them for cash in bags holding 3 pk. each at 40 ct. a bag. Find how much was gained.

26. From 60 reams of paper, how many books of 200 pages each could be made if a sheet can be folded into 8 leaves?

27. If 9 eggs weigh a pound, how many dozen eggs would weigh as much as 12 hogs, each of which would make $2\frac{1}{2}$ bbl. of pork? A barrel of pork weighs 200 lb.

Exercise 64

1. Read the following:

.4, .49, .495; .01, .1, .001; 12.8, 1.28, .128; 67.346, 78.35, and 19.6.

2. Write in figures:

Seven hundred, and fifty-four thousandths; seventeen and

sixty-three hundredths: two hundred and nine, and nine tenths; three thousand, and twenty-five hundredths.

3. Add:

(a) $74.6 + 98.73 + 248.079 + 26.483 + 8 + 9.72$.

(b) $249.5 + 72.85 + 8.346 + 93.72 + 41.305 + .972$.

4. A man has three piles of lumber. In the first there are 1.468 thousand feet, in the second there are 2.45 thousand feet, and in the third 4.25 thousand feet. How many feet of lumber are there in the pile?

5. From a block of land containing 10,000 acres I sold A 346.75 acres; B, 396.48 acres; and C, 240.52 acres. How much land is left, and what is it worth at \$8 an acre?

6. Find the difference between:

(a) 10 mi. and .428 mi.

(b) 20 gal. and .27 gal.

7. Multiply:

42.7 by 8; 9.63 by 9; 7.8 by 8.7; and 63.48 by 72.9.

8. Find the cost of:

(a) 2486 ft. of lumber at \$24.75 per M.

(b) 465 lb. of flour at \$1.85 per C.

9. Find the prime factors of 22,680.

10. The prime factors of a number are $2^3 \times 3^2 \times 5^2 \times 7$. What is the number?

11. Find, by the method of factoring, the H. C. F. of:

(a) 240 and 360.

(b) 270 and 420.

12. Find, by using the difference, the H. C. F. of 7560 and 8208.

13. Find the H. C. F. of 729 and 4374.

14. Find, by factoring, the L. C. M. of 37.48 and 64.

15. Find the L. C. M. of 18, 24, 32, 36, and 54.

16. Find the area of a right-angled triangle, whose base is 12 ft., and altitude 9 ft.

17. (a) Find the area of a triangle 12 ft. high if the base is 18 ft. long.

(b) A lot 6 chains long and 4 chains wide. Area to be given in square yards.

18. What will it cost to paper a room 36 ft. long, 20 ft. wide, and 9 ft. high with paper 2 ft. wide if a roll of 8 yd. cost 31 ct.?

19. Find the cost of plastering the ceiling described in question 18, with two coats of plaster, each coat costing 18 ct. per square yard.

20. How many planks, each 12 ft. long and a foot wide, will be necessary to build a sidewalk a mile and a quarter long and 6 feet wide?

21. How many feet of lumber will the foregoing walk take, the planks being 2 inches thick?

22. In a row of 24 houses each house has 15 windows, each window 4 panes, and each pane measures $1\frac{1}{2}$ feet by 12 inches. Find the cost of the glass required at 12 ct. per square foot.

23. A box with a lid is made of planking 2 inches thick. If the external measurements of the box are 3 ft. 4 in., 2 ft. 4 in., and 1 ft. 4 in., find:

(a) The amount of space inside the box.

(b) The lumber in the box.

24. How many bricks, each $8 \times 4 \times 2$ inches, will be required to build a wall 72 ft. long, 12 ft. wide, and 20 ft. high. Find also the cost of the bricks at \$7.25 per thousand.

APPENDIX A

The legal weights and measures of Canada are the Imperial yard, Imperial pound Avoirdupois, Imperial gallon (of 277.27384 cubic inches), and the Imperial bushel. The Imperial gallon is equal to 4.54174 litres, while the wine gallon, used in the United States, is equal to 3.785 litres.

By Act 42 Vic. (1879), Chap. 16 (amended by Chap. 30, Acts of 1898), it is provided: That in contracts for sale and delivery of any of the undermentioned articles the bushel should be determined by weighing, unless a bushel measure be specially agreed upon, the weight equivalent to a bushel being as follows:

	lb.		lb.
Wheat	60	Castor beans	40
Indian corn	56	Potatoes	60
Rye	56	Turnips	60
Pease	60	Carrots	60
Barley	48	Parsnips	60
Malt	36	Beets	60
Oats	34	Onions†	50
Beans	60	Bituminous coal	70
Flax seed*	56	Clover seed	60
Hemp	44	Timothy	48
Blue grass seed	14	Buckwheat	48
Lime‡	80		

By the same Act the British hundredweight of 112 pounds and the ton of 2240 pounds were abolished, and the hundredweight was declared to be 100 pounds and the ton

* Changed from 50 to 56 lb. by Act of Parliament, 1898. † Changed from 60 to 50 lb. by Act of Parliament, 1898. ‡ Added by Act of 1898.

2000 pounds Avoirdupois, thus assimilating the weights of Canada and the United States.

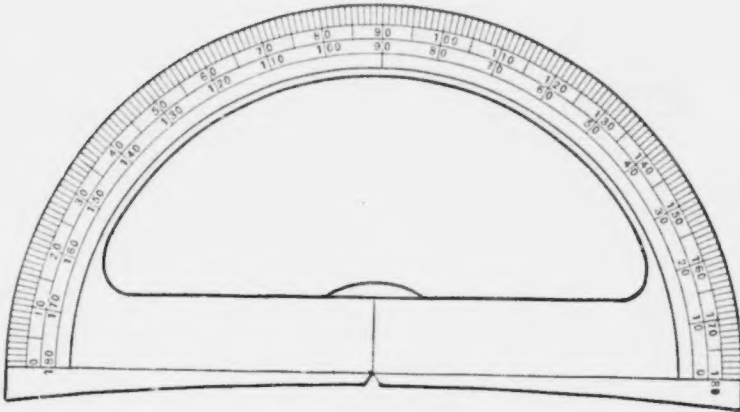
All articles may be sold by Avoirdupois weight. Gold, silver, platinum, and precious stones *may* be sold by the *ounce Troy*, and drugs *may* be sold by Apothecaries' weight.

TROY WEIGHT		APOTHECARIES' WEIGHT
24 grains (gr.)	= 1 pennyweight (dwt.).	480 grains = 1 ounce.
20 dwt.	= 1 ounce Troy (oz. troy).	12 ounces = 1 pound.
12 ozs. troy	= 1 pound Troy.	

APOTHECARIES' MEASURE (FLUIDS)

60 minims (min.)	= 1 fluid drachm (fl. dr.).
8 drachms	= 1 fluid ounce (fl. oz.).
20 ounces	= 1 pint.

APPENDIX B



Carefully paste this sheet upon cardboard; then cut out the protractor with a sharp knife and preserve it for use in measuring and in constructing angles.